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THE METRIC SYSTEM.

A communication from Prof. M. Ch. E. Guillaume, in our correspondence columns this week, draws attention to the steady growth of the metric system throughout the civilized world, and even within the English-speaking countries that still cling to their time-honored medley of weights and measures with a persistence that the historians of the future will have difficulty in comprehending. M. Guillaume advocates legislative action to render the use of the metric system compulsory through all the States, territories and dependencies of the United States government. At the same time he points out that it is not necessary to await legislation before initiating metric reform. Individuals can do something, and associations can do much, by mutual action and agreement to inaugurate the reduction from our customary complexity to metric simplicity. At the present time, practically all of the scientific work of the United States is conducted in the metric system. Empirical work and work that, while it may be useful, does not rise to the level of being scientific, is commonly conducted in the customary system. In fact, a fairly accurate judgment ordinarily admits of being made as to the character of any quantitative work published in the United States to-day, by observing whether it is expressed in metric or in the customary measures. If it is expressed in metric measure, the work is likely to be of scientific value and of the first quality. If it is expressed in the customary local measure, the work is likely to be empirical and of the second quality. The vast majority of engineering work of all qualities is, however, carried on in the customary system.

Great Britain and the United States are the two last strongholds of old-time measures, but the situation is somewhat different between them in regard to the metric movement. Great Britain is the more conservative, and the less inclined to change of any kind; but she is surrounded at close range by a number of European countries, all devoted to the metric system, so that the constant contrast between their orderly simplicity of quantitative values and her own rambling habits of complexity is irksome and distressing. Moreover, the constantly increasing keenness of commercial competition with foreign countries using the metric system in their daily life makes the old-time measures of Great Britain a handicap in business. Here in the United States, the competitive commercial difficulty has not yet seriously arisen, while the country is so large and so far from Europe that the constant chafe of friction with metric measures is hardly felt. Consequently, the incentive to metric reform is less felt in the United States than in Great Britain. Moreover, each wishes to see the other take the medicine of metric reform first.

PHOTO-ELECTRIC CELLS.

Voltaic cells may be divided into two classes—namely, wet cells and dry cells—that is, cells which will spill out their electrolyte, when upset, and cells which will not spill out their

electrolyte when upset. The dry cell is thus, in effect, a sealed up wet cell, although the electrolyte is not identical in both. The dry cell commonly contains a porous non-conducting medium which holds the electrolyte as a sponge holds water. A new type of cell has recently come into the limelight of investigation, and may be regarded as an ultra-dry cell. It is known as a *photo-electric cell.* It seems not to be a voltaic cell in the hitherto accepted sense of that term, because its e.m.f. is not in accordance with the expected contact potential difference of its metallic plates. It is, however, a dry cell, in the sense that there is no liquid between its plates. There is a vacuous space between them, or in other words, a close approach to a vacuum takes the place of the ordinary electrolyte.

A recent paper in the *Philosophical Magazine,* by Dr. J. A. Fleming, describes a form of photo-electric cell, its construction, and some of its properties. The cell is a glass tube, supported horizontally when completed. It contains a pair of metallic plates, each connected to sealed-in platinum wires. The upper plate is a strip of platinum. The lower plate is a fluid amalgam of potassium and sodium, which resembles mercury in appearance. Such a cell is devoid of e.m.f. when unillumined, and does not conduct electricity, because the glass cell tube is exhausted to a relatively high vacuum and then sealed. The cell is, therefore, a highly exhausted vacuum tube. When, however, a powerful projection lantern has its projected beam of light concentrated upon the potassium-sodium plate, it is stated that an e.m.f. of about half a volt is produced, the amalgam forming the negative plate or positive pole, and the platinum the positive plate or negative pole, so that a current flows from platinum to amalgam through the vacuum tube or negative electricity passes from the illumined amalgam to the platinum plate. Of course, the internal resistance of a cell containing a vacuum for its electrolyte can hardly be very low. In the case reported, it was about 75,000 ohms, so that only some 5 microamperes of steady current were produced from the cell on connecting it directly to a galvanometer. Under such conditions the cell must remain a scientific study, and not a commercial rival in the dry-cell business.

The action produced in this interesting cell by the beam of powerful incident light is the liberation of negative ions from the surface of the liquid amalgam. These negative ions permeate the vacuous space, and bombard the opposed surface of platinum plate, where they deliver up their electric charge on impact. The electric current in the external circuit comes from this liberated negative electricity. It appears that, within the visible spectrum, the violet rays are the most effective in the beam of incident light stimulating the cell. On the other hand, the yellow and red rays appear to be inactive. It is, of course, needless to discuss, from an economic standpoint, the permanence and durability of a cell having so high a resistance. It would seem, however, that the energy of the cell is derived from without, rather than from within, or from the energy of the incident light rays, and not from chemical potential energy in its plates. Consequently, such cells might reasonably be expected to last a long period without replenishment or renewal. If it were possible to construct such cells with plate areas so large as to have internal resistances as low as those of ordinary voltaic cells, and if they could be stimulated to activity by ordinary sunlight, then perhaps a battery of such cells would deliver power indefinitely, taking the energy from the electric intensity in the electromagnetic waves of the sunlight, and liberating this energy, or a part thereof, as a steady electric current stream. In other words, the cell appears to act as a rectifier of high-frequency alternating emf. through the intermediary of subatomic activities. While the extra-dry cell is not practical at present, it is extremely interesting.

Auto-Transformer versus Rheostatic Induction Motor Starters.

The relative advantages and disadvantages of auto-transformers and rheostats for induction motor starters are outlined by Mr. I. E. Hanssen in an article appearing in this issue. The author finds that the rheostatic starter consumes considerable power, while the auto-transformer dissipates almost none, and he therefore concludes that the latter is far preferable to the former. His observations are doubtless correct, and his conclusions as to the relative merits of the two types of starters are well founded if the comparative sizes, weights and costs of the two devices can be ignored. However, it is not improbable that in many cases the interest on the extra investment involved in the auto-transformer starter may more than equal the cost of the extra kw-hours dissipated in the rheostatic device during the starting period. The rheostatic induction motor starter is similar in operation to a direct-current starter connected in series with a motor whose armature and field coils are joined permanently in parallel. The objection that might be urged against the latter type of starter relates rather to the poor torque than to the dissipation of power. The torque can be improved by subjecting the field coils to the full line e.m.f. at all times, the operation of the apparatus under the latter arrangement being similar to that of a slip-ring type of induction motor using extra resistance in its secondary circuit at starting. The auto-transformer starter does not overcome the objection as to the low starting torque. Moreover, the extra volt-amperes taken by the rheostatic starter over and above the volt-amperes taken by the auto-transformer starter are directly in time-phase with the total impressed e.m.f. and hence have an inappreciable effect upon the voltage regulation. It would thus seem that the single important objection of extra power dissipation in the rheostatic starter may not always be sufficient to justify the extra cost of its older rival, the auto-transformer starter.

Effects of Light on the Eye.

Elsewhere will be found an interesting and suggestive paper by Professor Ashe on some of the relations of illumination to vision, which are just now often under discussion. The topic particularly considered is the relation of light-quality to visual acuity. There is already a large amount of literature on the subject, but, very unfortunately, it is scattered through the periodicals of several sciences, and very little of it is even adequately abstracted in English, so that Professor Ashe's article will be welcome to our readers. It is most inconvenient that the literature on so important a subject as physiological optics should be so difficult to find as it is. Since the last edition of Helmholtz, some 15 years ago, in which a good index up to 1894 was given, one has been compelled to grub in all

kinds of places for data. The researches have been published in physical, medical, physiological and psychological journals, and have been embalmed in the transactions of many societies often remote and unattainable. For example, the first great paper by von Kries on rod and cone vision is buried from American readers in the *Berichte* der Naturforschenden Gesellschaft zu Freiburg, 1895, and Uhthoff's splendid investigation of visual acuity reposes in Graefe's Archives, generally unknown save to ophthalmologists. For this reason there has been much repetition of work already done, and much time and labor would be saved were there an adequate index of the whole subject such as exists in some other branches of science.

Another stumbling block in the way of progress is that much of the work which has been done has neglected vital data of one sort or another. The functioning of the eye is profound, and unless this is clearly defined, the results are not properly comparable. For instance, while Professor Ashe's work was apparently done on the dark adapted eye, at least initially, other similar researches have dealt with the partially adapted or with the light adapted eye, and it is rather uncertain as to which state most fairly represents practical conditions in any given case. A still greater source of uncertainty lies in the character of the colored lights used where color vision is under investigation. To say that a light is red, green or blue means very little unless the exact color is clearly defined. To take the simplest kind of example, ordinary red such as is found in signal lanterns contains much orange and yellow, while the green contains much yellowish and bluish green. If spectral colors are employed, they must be clearly defined in order to give a basis of comparison. With some colored screens there is a good chance of shifting the effective color if the density of the screen or even the intensity of the light be changed; and in acuity measurements the extent of spectrum taken to represent any so-called color has a considerable effect, since, other things being equal, the more nearly monochromatic the light the sharper the definition. For example, a screen of "Hoffmann's violet" lets through enough red to make sharp vision very difficult, and some so-called blues have the same property. On top of all of this rest the unpleasant errors of color photometry, often big enough to hide wholly or partially the real phenomena under investigation. The moral of all this is that where investigations in physiological optics lead to discordant results when compared with similar work, one should not conclude that the work has not been thoroughly and skilfully done, but should investigate the conditions carefully to see in just what cases the results are applicable.

Perhaps the most important feature of Professor Ashe's paper is his very interesting investigation of the pupillary reaction due to the intrusion of bright light in the visual field. This is a matter of much practical moment, and its investigation requires a degree of care and patience that few readers will appreciate at its full value. The very practical observation that the intrusion of a single 16-cp lamp can decrease one's ability to read by something like 30 per cent, is one that we trust will be generally taken to heart. In spite of the campaign of education in illuminating matters, nothing is more distressingly common than to find a room lighted with bare lamps so placed that it is well-nigh impossible to find a place to read where one or more lamps will not intrude. And it should not be forgotten that the peripheral image of the intruder on the retina may produce serious permanent injury, sometimes even involving loss of the eye. It is hard to lay too much emphasis on the care that should be taken to avoid this particular danger. The case is made all the worse by the fact, well shown in the paper before us, that the iris does not react as effectively to excentric lights as to those seen directly, and hence the eye cannot defend itself effectively against them. A comparison of considerable theoretical interest is that between excentric illumination by white and by green light on the extent of pupillary reaction. The result showed materially greater contraction from the green light than from white light of the same apparent intensity, the difference apparently being more conspicuous toward the extreme outer edge of the field. Now, Abelsdorff showed some years ago that in working with spectral colors and approximately central vision, the pupillary reaction depended on the relative luminosity of the several colors. This is, of course, a natural enough state of things, since, after all, relative luminosity merely indicates relative visual stimulation on the sensory apparatus.

The present observation shows the extension of the same principle to excentric vision in a very interesting way. For to cone vision, which more and more predominates as one gets away from the fovea, green is the most luminous color, and hence produces the stronger stimulus on the pupillamotive mechanism. The same predominance of green light in pupillary reaction was noted by Hess in the dark adapted eye of the owl, in which the retinal elements are chiefly rods. We hope that Professor Ashe may find time to extend his investigation to excentric acuity, a matter of great theoretical interest as yet rather imperfectly worked up. All the careful investigations of recent years seem to add weight to the rod-and-cone vision theory of von Kries, and therefore bear also on the much-mooted theories of color vision, particularly on the relative sufficiencies of the Young-Helmholtz and the Hering theories. From a practical standpoint, human rod vision is not extremely useful under ordinary condition. When the illumination falls so low that the cones go out of business, the seeing is altogether too poor to be worth cultivating, and it is time rather to call for more light. There is very little in the fanciful idea sometimes expressed that for street lighting a source rich in green is desirable on account of its greater value at very low illuminations. When the light is so feeble that such a change of color would be significant, more light is the only remedy of any particular use. The differences found by Professor Ashe in the acuity values of various colors are similar to those determined by previous investigations; but so far as quantitative values are concerned, the difficulties of color photometry in getting equivalent intensities are too great to permit comparisons of high precision. The practically important conclusion is that even for low intensities, variations from approximate white do no particular good and may do harm, while at any reasonable working intensity white is ordinarily to be preferred for reasons quite independent of acuity. The long and short of it is that the human eye has been developed for daylight, and while it is tolerant of the wide range that daylight really covers, it was never organized for the utilization of freak illuminants, and is more than likely to resent their intrusion.

Heroult Electric Steel Refining Process.

The United States Steel Corporation has, after a thorough investigation, decided to install Héroult electric furnaces at two of its plants. A 15-ton Héroult furnace is now being constructed for the South Chicago works of the Illinois Steel Company and one of the same size for the Worcester plant of the American Steel & Wire Company. A third installation will probably be made later at the Homestead plant. The capacity of each of these furnaces is about 300 tons per 24 hours. At the Chicago plant the process will be applied to the manufacture of a special steel rail of high-grade quality, and at the Worcester plant the product will be used for a special grade of wire. In the former the electric furnace will take molten steel from Bessemer converters and, in the latter from open-hearth furnaces. The electric process is therefore simply a refining process in which the phosphorus and sulphur are reduced to amounts otherwise attainable only in crucible steel practice. At the same time the steel is thoroughly deoxidized and freed from all particles of slag. The largest Héroult steel furnaces formerly installed have a capacity of five tons. While the 15-ton furnaces of the U. S. Steel Corporation thus represent a trebling of capacity, the company contemplates the installation of even larger furnaces in future.

A. I. E. E. Anniversary Dinner.

Much interest is being taken by members of the American Institute of Electrical Engineers in the anniversary dinner at the Hotel Astor, March 11, celebrating the close of the first quarter of a century of its existence, and there is already evidence that there will be a record attendance. Owing to the difficulty in taking care of so many persons, members are requested that in filing their notifications they will designate with whom they would like to sit, making up complete tables of 8 or 10 persons. Table allotments will be made as rapidly as these requests are received, the location of the tables being determined by ballot. In connection with this dinner the council has made preparation for a special certificate of congratulation, which will be given to each of the charter members, of whom about 30 are now living, out of the total membership of 6200. Each of the branches and sections has been requested to have a special representative in attendance, and the various sister societies are to be officially represented on this occasion. The announcement as to speakers and other particulars of the program will be made next week.

Proposed New England Water-Power Developments.

The Connecticut River Company announces that its plans to build a dam acros the Connecticut River between Windsor Locks and Enfield call for the utilization of about 10,000 hp which are now going to waste. An additional canal will be constructed and the company states that the scheme will not interfere with any navigation projects. Electric power generated will be sold for industrial service. The Northern Connecticut Light & Power Company, which owns certain franchise privileges in the same territory, desires to have the Connecticut River Company's operations somewhat restricted, the case being in some degree parallel to the case of the Fitchburg Gas & Electric Company and the Connecticut River Transmission Company, now pending before the Massachusetts Gas and Electric Light Commission.

The Goodell Cutlery Company, of Antrim, N. H., is preparing to utilize the largest water-power privilege available on the Contoocook River by the construction of a 500-kw electric plant which will supplement the existing water power used by the company. A 500-kw generator and a set of horizontal water-wheels have been purchased, to operate under 80-ft. head.

The Oxford (Mass.) Linen Mills Company has bought land and water rights on Mad Brook, to develop water power for electrical transmission near North Brookfield. Power will be transmitted to the company's plant two miles distant. It is planned to build a dam 80 ft. high and 60 ft. long. From 150 hp to 200 hp will be installed initially.

Effect of Niagara Ice Gorge on Electric Power Plants.

It is highly probable that no single field has heard more of the great downpour of water at Niagara Falls than that associated with the electrical industry, for ever since man became interested in the development of electric power frequent reference has been made to the possibilities of Niagara, and these have served for comparison with the resources of other places in the matter of power. However, Niagara Falls has recently passed through an experience that was astonishing to the power interests, while the scenic lovers were amazed by the actual passing away, temporarily, of course, of one of the waterfalls that go to make up the world-famed Cataract.

The Falls of Niagara have several times before been in that condition termed "dry," but this does not mean actual dryness. On March 29, 1848, there was a memorable dryness, but not until March 22, 1903, were the residents again astonished by the conditions. In 1905 a similar spectacle existed, and this year the strange sight lasted over three days—Sunday, Monday and Tuesday, Feb. 14, 15 and 16. The unusual conditions are developed by a continued east wind, which has the effect of blowing the water back up Lake Erie, greatly lessening the discharge from the lake into the river channel at the foot of the lake. When this occurs in winter time, as on the dates mentioned, there is usually considerable ice in the river, and this lodges on bars and reefs at the head of Goat Island and in the upper river, as well as throughout the American channel between Goat Island and the New York mainland. With low water prevailing generally in the river, it is an easy matter for the mass of ice to divert what water might go through the American channel to the Horseshoe channel, and in this way the American channel is first to feel the changed conditions under such circumstances.

For three days the American channel was practically dry. Stretching far up the river from Goat Island was an ice field that swept by the inlet canals on the New York side. A little water trickled through here and there, finding its way toward the falls through the low dip of the channel close by the New York mainland, but beyond this toward Goat Island the river bed was high and dry, affording people every opportunity to investigate it at will and with great freedom. Men crossed from the mainland to Goat Island above the island bridges, and crossings were made from Luna Island to Prospect Park not far back from the brink of the American Fall, but this feat called for the protection of rubber boots. Others made their way up from Goat Island toward the inlets of the power companies.

While these unusual conditions prevailed, the depth of water in the surface canal of the Niagara Falls Hydraulic Power & Manufacturing Company, as well as in the inlet canal of the Niagara Falls Power Company, was materially reduced, neither company being able to carry its full power load. Practically the same trouble existed with the power plants on the Canadian side, and each one was kept very active during the days of the "dryness." Dynamite was used freely, particularly on the Canadian side, and after the water started to raise, the power companies were kept busy in opening a channel so that ice floes from Lake Erie might pass down stream freely instead of being retarded to interfere with the flow of water into the inlets.

Not until Wednesday morning, Feb. 17, was it observed that the wind had changed and Lake Erie had started to send her flood down to Niagara. The river did not quickly regain its normal condition. On the contrary, it took days, and it was only after many hours that Niagara resembled herself. During the period of time the river and falls were affected by the wind and ice, the American Fall presented a tear-dripped, shame-

faced appearance. It was indeed a ragged spectacle, as the face of the cliff was hung with huge stalactites, washed by a little stream here and there.

Considering what they passed through, the power companies feel that they came out of the battle victors. They hardly expect another such strife this season, and yet they admit there is no telling just when wind and ice will call them to a similar fight for water to keep their turbines going.

New York Public Service Commission Modifies Its Rate Regulation Order.

The New York City Public Service Commission has issued an order amending Section 4 of its order dated Dec. 18, 1908, and printed in our issue of Jan. 2, 1909, requiring that every electrical corporation shall print, post in its office and file with the commission, schedules giving all the rates charged or to be charged, forms of contract, riders modifying these forms and the general rules and regulations relating to rates, contracts and the use of electricity by the public and of apparatus furnished by the company. A clause of Section 4 of this order provided that "An exact copy of every form of contract and schedule of rates, each to be followed by an exact copy of every form of rider applicable thereto, shall be filed by the commission."

This order was accepted by all the companies within the jurisdiction of the commission except the New York Edison Company, the United Light & Power Company, and the Edison Electric Illuminating Company of Brooklyn, who objected to this particular clause, and at their request a rehearing was held on Feb. 5, a report of which appeared in our issue dated Feb. 11. As a result of this rehearing the commission has modified the clause in question so as to read as follows: "An exact copy of every form of contract and schedule of rates each to be followed by an exact copy of every form of rider applicable thereto; but any corporation may insert at its discretion in any contract a standard clause relating to any minor service condition, provided such standard clause shall first have been submitted by the said corporation and approved by the commission."

The principal objection made to the original order was that it would not allow the companies leeway upon "minor service matters." The companies stated that a consumer now and then insisted that there should be inserted in his contract an agreement upon the part of the company to read his meter weekly or on the first of every month, to render duplicate bills, to supply the most efficient type of lamps, to provide service connections at specific points, to locate the meter in a selected place, or perform some other similar service. To the suggestion that these matters be omitted entirely from contracts, the companies replied that they would gladly do so but that the consumer would not accept a verbal promise to that effect. The companies also claim that it would be impossible to grant these minor requests, it being impracticable for them to attempt to read meters for all consumers on the first day of the month, for example.

At the rehearing it was suggested by two of the corporations that they should be permitted in their discretion to insert or refuse to insert in any contract any clause relating to minor service conditions. This the commission refused to agree to, as it would open a way for an evasion of the entire order. In the amendment as adopted it will be necessary for a company to come to the commission and secure its approval before any change is made in the standard form of contract. The chief objection urged against the adoption of this amendment was that it would interfere with the freedom of the corporation. In regard to this objection, Commissioner Maltbie, in his opinion, says:

"Every corporation which performs a *public* service must, because of the nature of its business, submit to certain regulations which are not applicable to private corporations. Publicity of all rates, charges and service conditions is one of these, and equality of treatment is another. The assertion of the representative of one of the companies that the making of contracts is its 'private business' indicates that he has forgotten the generation in which he is living. If this were true, there would be no Public Service Commission."

As to the other objections raised by the three protesting companies, Commissioner Maltbie says: "The three protesting companies assert that the order limits the right of the companies to make contracts, and therefore is improper. But they are forced to admit that no public service corporation even now has entire freedom to make any contract. If it had, it could make agreements containing discriminatory notes. If their rights are limited to the extent that public service corporations cannot make unequal rates, why should they not also be prohibited from offering unequal service? Common carriers have been; why not electrical corporations, especially those which have virtual monopolies?

"But it should be clearly understood that the order in no way limits the right to make contracts, provided every person in a class is given the same rate and offered the same service, and provided the exact form of contract shall have been published so that every consumer may know what rates and service he may have as well as some favored consumer. The statement, therefore, that the publicity order makes it 'impossible for the company to obtain certain important classes of business and precludes the company from making any change in any form of contract' is inaccurate. The order does not prescribe directly or indirectly what a contract shall contain. Any company may make a rate as low as it pleases, give all the privileges it desires to give, and amend, extend and change in any way the forms of contract ad libitum. But it must treat every individual in a class alike, and it must publish its forms of contract so that all may see them.

"Further, the commission, in Order 823, does not undertake in any way to pass upon the propriety or impropriety of any form so established. Doubtless Order 822 against discrimination, etc., and Order 823, requiring publicity, prevent a company from offering special rates or special privileges to one prospective consumer that are not offered to all, and possibly there may be persons who will not take current from a supply company unless they are given a discriminatory contract. But this is no adequate reason why discriminatory contracts should be permitted, and the companies that make such an argument are most illogical when they say so. The same argument was and could still be urged against the law requiring common carriers to print, post and file their schedules; indeed, every objection made by the three companies applies equally to the requirements as to common carriers; but no public body would think of returning to the condition which once existed where rates and privileges were secret matters and only favored shippers knew what could be obtained. Even those who were favored one day were outside of the inner ring the next. Publicity of such matters has come to stay.

"The three corporations asking for this rehearing assert that the commission has no power to issue Order 823. The commission believes that it has this power. However, if the Legislature has not conferred the necessary authority to do such a reasonable thing as to require rates, contracts, etc., of electrical corporations to be publicly posted and filed, like those of common carriers, it is a fact that ought to be made known to the Legislature and to the public generally as well as to this commission."

In commenting upon the modification of the order of the commission, Mr. Henry J. Hemmens, counsel for the New York Edison Company, said that there is no doubt in his mind that the requirement for the publication of all contracts and every possible form of rider, condition or change of a word or phrase or sentence in a contract is, on its face, unjust, unreasonable and unwarrantable, and might even be construed as an interference with the detail of the business management of the corporation. To enforce such an order as the Public Service Commission issues would, he said, place the electric companies in the position of being arbitrary with customers, instead of trying to

meet the convenience of the public in every way where they can do so without unreasonable or improper discrimination. He said he knew of no case where any public authority or commission, with or without the necessary statutory powers, has ever undertaken to make such arbitrary, unreasonable and restrictive regulations over the conduct of a business. It is emphatically denied by the electric companies that they are discriminative or seek to discriminate, although that intimation might be inferred from a published interview with Commissioner Maltbie.

"The interstate commerce law specifically gives certain powers to the Interstate Commerce Commissioners with reference to publicity, schedules of rates, etc. We do not find that the Legislature of this State has conferred any such power on the Public Service Commissioners with relation to electric companies, nor do we believe that the Legislature ever intended that the commission should have such powers under the statute as it has assumed."

Hearing on Connecticut River Transmission Company's Franchise.

The Massachusetts Gas and Electric Light Commission gave a second hearing at Fitchburg on Feb. 9 on the petition of the Fitchburg Gas & Electric Company remonstrating against the terms of the franchise granted by the Board of Aldermen of 1908 to the Connecticut River Transmission Company. An account of the first hearing appears in the issue of Feb. 11. The full board was present. The transmission company was represented by Mr. Jeremiah F. Smith, Jr., of Boston, and Mr. David I. Walsh, of Fitchburg, and the Fitchburg company by Mr. Everett W. Burdett, of Boston, and Mr. Charles E. Ware, of Fitchburg.

Mr. N. C. Grover, of J. G. White & Company, constructing engineers for the transmission company, was first recalled by Mr. Burdett. Questioned about the records of floods occurring on the Connecticut River at Vernon, Mr. Grover stated that he had found certain flood marks of freshet water and ice formation on trees and other objects at a grade possibly a little above the level of the top of the Vernon dam. In times of high freshets the dam would probably be submerged, leaving the wheels inoperative. The wheels would probably not operate with a head of less than 12 ft. or 15 ft. between head water and tail water. With 10 ft. of water over the top of the dam and a reduction of the same amount below, the wheels would operate. If the wheels were run below normal speed their efficiency would be somewhat reduced. From French King Rapids to Vernon is a distance of about 16 miles, and the slope of the river between these points is not much over 9 in. per mile. A rise of 20 ft. in the French King gorge would carry the water above the top of the Vernon dam. There is no other way of escape for the water at the French King Rapids, in case it backs up. The height of the dam at Vernon is 30 ft. without flashboards, and 34 ft. with them. The use of flashboards might dam up the river to some extent and thus restrain the flow. A rise of 25 ft. in the river would give a rise of about 12 ft. of water above the dam. The flashboards would be used only in times of low water. Thirty miles above the Vernon dam is the dam of the Bellows Falls Canal Company. The charter of the Connecticut company forbids it to back water up over the Bellows Falls dam, but Mr. Grover did not think the Bellows Falls property would be affected within 2½ miles of the latter's tail-race.

In redirect examination by Attorney Smith Mr. Grover emphasized the fact that these freshet marks were those of floods occurring at long periods of 50 years or more, as indicated by the records of the United States Geological Survey for Sunderland, Mass. Each generator is provided with three waterwheels, one of which is utilized during flood periods, and not in low stages of the river. A diagram was presented to the commission showing the estimated amount of auxiliary steam power that would be necessary for supplementing the river power at times of low water, but not in times of flood. The estimated yearly output of the plant is 50,000,000 kw-hours, of which the steam auxiliary is expected to furnish about 6,000,000 kw-hours in an average year's flow. The flood periods would of course be of much shorter duration than those of low water. The auxiliary steam plant would naturally increase the expense, but it is necessary to give the proper service. The testimony of a number of motor users was then taken to show that they were in favor of the cheaper energy promised by the transmission company.

Mr. Charles I. Main, of Boston, who was then called by the transmission company, has been identified with the work as a consultant since its inception. He had examined the records of the Holyoke Water Power Company, and had made allowances for the difference in drainage area at Holyoke and Vernon. On this basis he felt that once in 25 or 50 years it might happen that the Vernon plant would go out of commission on account of freshets. Perhaps once in 10 years the backwater might make it possible to deliver only the primary power of the station. Nearly every year the river could provide power without the use of auxiliary steam plants more than three months of the time, the latter being not necessarily continuous. The Vernon plant would not be affected any more than many of the installations on the Merrimac River, for example. It will probably be necessary to retain part of the night flow of the river in order to carry the load on the plant the next day. This holding back of the water would occur in the times of low flow in the river. If the highest output of the Vernon plant should occur mainly in the 12 hours of each day instead of a lower output continuously, the water would flow out of the basin so rapidly that it would be necessary to utilize storage at night. The flow into the pond above the French King Rapids could be made more even by the construction of a second dam at French King, and with this done, and with the use of flashboards at the Turners Falls dam below French King, the irregularities of the flow of the river could be overcome to a large extent.

Under cross-examination Mr. Main said that the Vernon dam is now practically completed and that the company should be able to furnish electric energy early in the coming summer. The French King dam is needed mainly to back up the water toward Vernon in case 12-hour power mainly is sold by the Connecticut River company. A steam auxiliary is absolutely necessary in order to be able to deliver power to anywhere near the full capacity of the plant. The capacity of the plant on the hydraulic end at Vernon without the creation of a basin or steam plant construction is estimated at about 2775 hp for 24 hours. If the company was not obliged to supply anything but secondary energy it would not be necessary to have the storage basin, but for the operation of a well-rounded and practicable scheme auxiliary steam plant capacity and the dam at the French King Rapids are absolutely essential, while a storage reservoir above the Vernon dam is highly desirable from the business standpoint. If only secondary energy were sold, supplementary steam capacity would not be needed, but practically it is certain that both kinds of energy will be demanded. Primary energy is essential in dealing with the small consumer, who usually has no plant of his own. Mr. Main was not surprised that in the three months beginning Sept. 30, 1908, the average 24-hour hp available at Vernon was about 2786, with only 2250 hp available for a portion of that time. He admitted that a storage basin is a necessity under such conditions.

Attorney Smith stated that the estimated cost of the whole work, exclusive of the proposed dam at French King, exclusive of steam plant capacity, but including transmission lines and all the plant, with its hydraulic construction, would be about $2,500,000. It is not planned to erect a steam plant at Vernon; it may be built anywhere, or the plants of customers who will use secondary energy may be turned to account to help out the transmission company in times of low water. Mr. Main defined primary energy as that which can be delivered from water without any steam plant assistance except once or twice in 50 years. Secondary energy was defined as the excess above

the primary which can be delivered at any time. The cost of the Vernon development would be about 25 per cent more than the development at Taylors Falls, Minn., per horse-power on account of the lower head. The general result is that as the head increases the cost of development per horse-power decreases. The maximum capacity at Vernon is about 16,000 hp, the initial installation being five 2500-kw units. To fulfil the whole requirements at the full output of the plant in all seasons, it might be necessary to install a large capacity in steam plant auxiliaries. Mr. Main stated that the wheels would give 2000 kw per unit down to about 18-ft. head, against 2500 kw at full head. A 5000-hp steam plant would practically take care of the extreme high-water conditions. The dam at French King could probably be built in one season.

Mr. Kenneth B. Thornton, of J. G. White & Company, then testified for the transmission company that the estimated cost of operating the plant when finally completed would in an average year be about $153,000. This estimated a steam plant production of 6,000,000 kw-hours at 1 cent per unit. This total sum did not include depreciation. It was figured that the plant would sell 50,000,000 kw-hours per year at 1 cent, bringing in $500,000. The taxes were figured at 4 per cent of the gross earnings, or $20,000; salaries of officers, directors' allowances, and office expenses were $12,500; depreciation, 2 per cent of the cost, $50,000; and interest at 6 per cent, $150,000. The total expenses were figured at $353,000 in an average year. The labor cost at the plant was estimated at $10,260, covering the services of a superintendent, shift operator, assistant operating foreman and machinists for two daily shifts. The labor cost of operating the transmission lines from Vernon to Clinton was figured at $6,960. Mr. Thornton stated that the transmission company planned to make reciprocal energy contracts whereby it might dispose of a considerable amount of secondary energy to consumers large enough to hold in reserve steam plants of their own, which could be turned into the system to help out in the production of primary energy in times of low water. The hearing was then continued to Friday, Feb. 19.

Annual Meeting of American Electrochemical Society.

The annual meeting of the American Electrochemical Society, which is to be held at Niagara Falls on May 6, 7 and 8, promises to be one of the most important gatherings in the history of that society. During the year Mr. Acheson has been president of the society unusual efforts have been made to secure new members, and the growth has been most satisfying. Thus the old members and the new members will have opportunity, in many cases, to meet and extend greetings for the first time and realize that they have become united in what appears likely to be the greatest field of industry.

Special efforts are being made to interest electrometallurgists in the society, for it is realized that this society has more in it for workers in the electrometallurgical field than any other organization. This is particularly true at this time, when the electrical furnace is being adapted for steel making. It is worthy of note that the first day of the convention is to be devoted to papers on metallurgy of iron and steel.

A letter has been received from M. Gustave Gin, of Paris, in which he promises to send in "an important paper." M. Gin has worked on several types of electro furnaces in the manufacture of calcium carbide, ferro-alloys and steel. His principal steel furnace is installed at the Krupp Works. M. Girod has cabled that he will send a paper. The Girod steel furnace is a type of which little is known in this country, although it is being extensively exploited in Europe.

Mr. John Hay, manager of the Grondal Kjellin Company, Ltd., has written that a paper mill will be sent by Dr. Kjellin. The latter is the inventor of the Kjellin furnace, and is one of the directors of the European company which makes several different kinds of furnaces, using the induction principle. Dr. Kjellin's paper will include much interesting data on the new 8-ton Röchling-Rodenhauser steel furnace, working at Volklingen, Germany, about which nothing has yet been published. This furnace has now been working for some time, and has been giving unexpectedly good results.

A paper on the Héroult steel furnace is expected from Mr. Robert Turnbull, who for several years has acted as Dr. Heroult's chief engineer. This paper is likely to be of unusual interest because two of this type of furnaces are being built by the U. S. Steel Corporation.

In addition to these papers others are expected from the principal workers in the electrometallurgy of iron and steel, such as Keller, Stassano, etc. Dr. Haanel, who has recently returned from Sweden, has also been invited to present a paper.

Dr. Bell on Street Lighting.

Dr. Louis Bell delivered an instructive illustrated lecture on "Street Lighting" at a meeting of the New York Electrical Society, held on Feb. 17. The lecture dealt largely with foreign practice, which he held to be much in advance of American practice with reference to the lighting of the principal streets of cities. It has not been uncommon in the past for foreign cities to expend five times as much electrical energy per mile of street and to use lighting units twice as efficient as found in this country. Moreover, the lamps are better arranged for effective illumination than in America. The enclosed arc lamp that has been considered standard in this country has never been adopted for general illumination abroad. It consumes about 1 watt per candle as compared to ½ watt per candle taken by the open arc lamp. Dr. Bell explained that the inability to obtain suitable carbon electrodes cheaply for the latter lamps at a reasonable price was the chief cause for the adoption of the enclosed lamps in America. At the present time the highly efficient yellow flaming-arc lamps, both with vertical and with inclined electrodes, are displacing the older open carbon arc lamps in foreign cities, while American cities have been slow to abandon the uneconomical enclosed arc lamps for street contracts.

During the lecture, an operating display was made of the various types of lamps that are in use for street lighting, including open and enclosed carbon arc lamps, the magnetite lamp, the indoor miniature white flaming-arc lamp, the yellow flaming arcs with vertical and with inclined electrodes, carbon, Gem and tungsten incandescent lamps. The operating characteristics of each type were fully explained.

By means of numerous lantern slides, Dr. Bell showed in what respect the foreign methods of placing the lamps differ from the methods used in America. The height of suspension is usually from 50 per cent to 100 per cent greater than the height employed here. In many places the lamps are hung from brackets supported from houses, while the common method is to place along the center of the street at frequent intervals artistic poles, each carrying from 2 to 12 flaming-arc lamps. One very interesting and novel view was of a four-story building with four quartz mercury-vapor type of lamps on roof fixtures, giving the tremendous volume of 12,000 cp on the street. There was an interesting discussion by Messrs. Farley Osgood, C. F. Scott and others. Mr. Theodore Beran presided.

Minnesota A. I. E. E. Section Meeting.

The Minnesota section of the American Institute of Electrical Engineers held a regular monthly meeting Monday evening, Feb. 15, at the offices of the Twin City Rapid Transit Company. The Institute paper of the evening was "Prime Movers," by Charles Proteus Steinmetz, of Schenectady, N. Y. The discussion was led by Dr. H. T. Eddy, of the University of Minnesota. Officers for the ensuing year were elected as follows: Chairman, Barry Dibble, St. Paul; secretary, J. C. Vincent, Minneapolis; executive committee, Arthur L. Abbott, of St. Paul; Edward P. Burch, of Minneapolis; Barry Dibble, of St. Paul; E. H. Scofield, of Minneapolis, and J. C. Vincent, of Minneapolis.

Prime Movers.

At a meeting of the American Institute of Electrical Engineers, held on Feb. 19, a paper by Dr. C. P. Steinmetz entitled "Prime Movers" was read in abstract by Mr. Ernest J. Berg in the absence of the author. In addition to outlining the characteristics of the various hydraulic steam and gas turbines and steam and gas engines, Dr. Steinmetz discussed the cost of electrical energy as affected by the interest on investment, the operating expense and the so-called "reliability insurance." In connection with reliability insurance the interruptions in electric energy supply systems were arranged into four classes, distinguished according to the length of shutdowns. In Class A were placed shutdowns of less than one second; Class B, shutdowns of less than 20 minutes; Class C, less than three hours, and Class D more than three hours.

According to Dr. Steinmetz, in estimating the reliability of service the shutdown of a part of a system would be considered as a part of a shutdown in proportion to the connected load. Voltage variation beyond the limits permissible in good service —about 2 per cent in lighting and 10 per cent in industrial supply—would be considered as a partial shutdown, about in the following manner: The voltage variation of from 2 per cent to 10 per cent would be considered as one-tenth of a shutdown in a lighting system, but would not be counted in an industrial system. A voltage variation of from 10 per cent to 50 per cent would be considered as one-half of a shutdown; a voltage variation of over 50 per cent would be considered as a complete shutdown. In order for a service to be considered first-class there should be less than four Class A shutdowns, and less than one Class B shutdown per year, and there should be no Class C or Class D shutdowns. Good service would permit of as many as 12 Class A, 4 Class B and 1 Class C shutdowns per year. Second-class service would be that in which there were not over 52 Class A shutdowns, 12 Class B, 4 Class C and 1 Class D. When the shutdowns exceed the above values the service would be considered either third-class or as entirely unsatisfactory.

Dr. Steinmetz discussed thermodynamic cycles using steam and air as the working fluids. He showed that the available energy of the air cycles per kilogram of air is insignificant until high temperatures are reached and that even at a temperature of 800 deg. C. it is still much lower than that of the non-condensing steam cycle. It must be considered, however, that the volume of steam per unit weight is 58 per cent greater than that of air at the same temperature and pressure. The thermodynamic efficiency of the air cycles is less than that of the steam cycles for lower temperature, but rises far above it at higher temperatures. He stated that the gas-engine cycle shows a very much higher thermodynamic efficiency than does the steam-engine cycle; even when allowing for the lower mechanical efficiency resulting from the higher mechanical stresses the efficiency of the gas engine is still very far above that of the steam engine, especially when gaseous fuel is directly available and no producer plant is required.

In discussing Dr. Steinmetz's paper, Professor Charles E. Locke expressed his regret that the author was not present because he questioned the accuracy of certain of the demonstrations. He stated that the usual expression for the thermodynamic efficiency has no direct bearing on the actual efficiency, but represents merely a limit beyond which it is impossible to go. He said also that in the gas engine no account need be taken of the temperature changes. What one is interested in is the ratio of the energy transformed into work to the energy contained in the gas. He stated that in thermodynamics it is possible to draw almost any conclusion that one may wish, provided he makes initially those assumptions which will permit of such conclusions, and expressed his belief that the assumptions made by the author were not in accord with results practically obtainable.

Mr. D. B. Rushmore said that in comparing different installations of prime movers, it is necessary to take into account the fact that the gas engine has a very much smaller overload range than has the steam engine, while the overload range of the steam turbine is enormously greater than even that of the steam engine.

Mr. Henry E. Longwell compared the results obtained in the operation of a generating station with the product from a manufacturing establishment, and claimed that good results depend equally as much upon personal factors as upon the equipment installed.

Mr. Calvert Townley drew attention to the efforts that are now being made for placing a high tax upon water-power developments. He expressed the opinion that such action does not produce the desired result because developments should be encouraged as much as possible. Many persons have mistaken impressions concerning the profit to be derived from hydro-electric installations. When one takes into consideration the large variation in the flow of water, the necessity for providing reserve equipment and the low loading factor of the output, he will appreciate the fact that the interest on the investment represents a large proportion of the cost of producing the electrical energy. In fact, in many cases it is much cheaper to install a steam station than to depend upon hydraulic developments.

President Ferguson announced that at the next meeting of the American Institute of Electrical Engineers a paper dealing with industrial power will be presented by Mr. B. R. Shover, of the Indiana Steel Company.

Street Lighting Discussion at Chicago.

The Chicago section of the Illuminating Engineering Society at its meeting Feb. 18 discussed a paper on street lighting by Walter C. Allen, of Washington, D. C. Much of the discussion centered about the conditions actually existing in Chicago.

Mr. Wm. Caroll, city electrician, was asked many questions as to costs of various types of lighting. He brought out the interesting fact that in 13 years the total cost of lighting the streets of Chicago has decreased 7 per cent, while the candlepower has increased 300 per cent. This has been brought about by the substitution of arc lamps and gas mantle burners for the old flat flame gas burners with which a large part of the lighting was done 13 years ago. The city has a variety of methods of street lighting, including arc lamps furnished by the city, arc lamps furnished by a private company, gas-mantle burners, open-flame gas and gasoline mantle burners. The present gas mantle burners cost the city about $19 per year, each, burning all night every night, including all costs of maintenance. The flat-flame open gas, although consuming more gas, costs only about $17 per year.

Chairman Cravath called attention to the very meager lighting provided in the majority of smaller towns throughout the Central States, where arc lamps are placed only on every other corner. He showed that with tungsten lamps of 80 cp placed on each corner much better results can be secured than with a 6.6-amp, alternating-current, series enclosed arc on every other corner, although even with the tungsten lamp on each corner the illumination would leave much to be desired.

Investigation of Michigan Hydro-Electric Companies.

Following a newspaper rumor that certain Michigan hydro-electric companies have formed a combination for the purpose of gaining control of all valuable water-power rights in the State, the Michigan Legislature has appointed a committee to investigate the hydro-electric companies of the State, which will also take up the question of the power to revoke grants of water-power privileges. In the discussion of the latter question, it is stated that the Supreme Court of the State has held that a navigable stream is any which may be used to convey valuable flotage, thus making practically every stream navigable; and it is contended that in consequence all water-power companies are merely holding their rights by sufferance and that all grants are subject to revocation by the State.

Meeting of Fort Wayne A. I. E. E. Section.

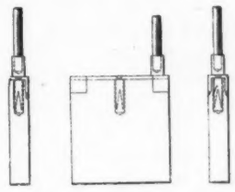
At a meeting of the Fort Wayne section of the American Institute of Electrical Engineers, held Thursday evening, Feb. 11, Mr. J. J. A. Snook opened the discussion of the subject of "Electric Heating," covering in a general way the different grounds upon which this subject has been advanced to the present time and the prospects for its future progress. In the discussion which followed attention was directed to the electric heating of cars on the railroad lines which at the present time are being electrified. Attention was also paid to the subject of electric furnaces, such as those now being developed for the treating of tool steels. The discussion then turned to the subject of electric welding, both by means of heat applied by the direct flow of current and by means of the electric arc. Several of the members detailed their experience in this line and gave interesting information for the benefit of the others present. At the next regular meeting, Mr. T. R. Cook, of the Pennsylvania Railroad, will present a paper on railroad car lighting.

February Meeting of the Pittsburg A. I. E. E. Section.

The regular February meeting of the Pittsburgh section of the American Institute of Electrical Engineers was held at Carnegie Institute on Feb. 9, 1909, Mr. W. Edgar Reed, chairman, presiding. The usual dinner preceding the meeting was held at the University Club. Mr. L. F. Howard, of the Union Switch & Signal Company, presented an original paper entitled "Railway Signaling," which was illustrated by means of lantern slides. Invitations were issued to leading representatives of the railway systems in and about Pittsburgh, as the subject of application of electric signaling to both steam and electric railway systems was considered. The discussion was participated in by Messrs. T. H. Patenall and A. G. Wilson, of the Union Switch & Signal Company; Mr. I. S. Raymer, of the Pittsburgh & Lake Erie Railroad; Messrs. H. L. Kirker and A. W. Copley, of the Westinghouse Electric & Manufacturing Company, and Mr. Wm. Hoopes, of the Aluminum Company of America. The next meeting is to be held on the second Tuesday in March and will deal with the application of electricity to steam railway systems.

Securing Conductors to Carbon Brushes.

The ordinary method for "pig-tailing" a carbon brush is to drill a hole through the brush near the upper end; fit a brass bolt snugly to this hole; solder the pig-tail to the end of the bolt and secure the latter to the brush by means of a nut and washer on the front face of the brush. If the brush holder has

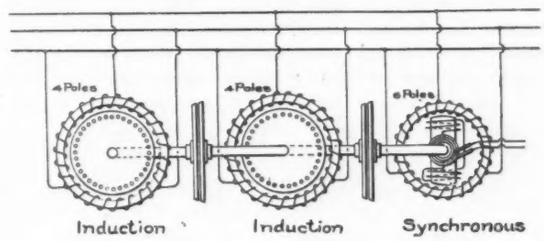


SECURING CONDUCTORS TO CARBON BRUSHES.

no slot down the front of the box to accommodate the nut, the latter is countersunk flush with the face of the brush. There are also numerous patented arrangements for securing the conductors to the brushes. In one, the outer end of the brush is provided with two or more cavities, the end of the brush being covered with a plate from which split pins project into the cavities, a flexible conductor being connected to the plate. With this arrangement it is necessary that the distances between the cavities and the pins be equal and that the pins be parallel, or else difficulty is experienced in applying the plate to the end of the brush. Mr. Norman W. Storer has patented a somewhat similar arrangement shown herewith. In this there is but a single cavity in the outer end of the brush and one or more recesses in the face of the brush in which projecting portions of the plate may be located. The arrangement has the advantage that the parts may be made interchangeable without the exercise of extraordinary care in drilling the cavity for the split pin or resilient wedge. The pin serves to retain the end plate in position while the lips or projections serve to prevent lateral displacement of the plate. The latter also serves as a wearing piece upon which the spring-pressed arm of the brush holder may rest.

Turbine-Driven Asynchronous Generator.

The accompanying illustration shows in diagram form a turbine-driven generator patented by Mr. E. J. Berg on Jan. 19. The turbine is divided into two stages, the adjacent wheels of which are mounted on the same shaft, while the two outer wheels have individual shafts. The three shafts drive three generators wound for the same e.m.f. and operated in electrical



TURBINE-DRIVEN ASYNCHRONOUS GENERATOR.

parallel. Two of the generators are of the induction (asynchronous) type arranged for high speed, while the third is a lower-speed synchronous alternator, which is excited by direct current and supplies alternating current for exciting the induction generators and assists in carrying the load. The generators deliver the same frequency, but each type operates at the speed best suited for its construction.

Quartz Tubes for Mercury-Vapor Lamps.

Two patents issued Jan. 26 to Dr. C. P. Steinmetz are of particular interest at this time by reason of the date of application being in 1902. The patents relate to mercury-vapor lamps, in which use is made of quartz tubes so that the temperature of operation can be much higher than is possible with glass tubes, and thus the efficiency can be increased and the color of the light improved. In forming the lamp tube a carbon conductor is embedded in a mass of quartz granules. Current being passed through the carbon, it becomes heated and the neighboring quartz is fused to form a shell around the conductor. The tube is allowed to cool and the carbon is burned off by means of an electric arc. The leading-in wire is made of a composition of steel with 37 per cent of nickel, which has the same temperature coefficient of expansion as the quartz.

The leading claim of one of the patents, the application for which was filed on Nov. 17, 1902, reads as follows:

"In a vapor-electric device, an inclosing chamber formed out of fused quartz and provided with means for conducting thereinto." A modification is covered by the second patent, the leading claim of which is as follows:

"As an article of manufacture, a tube having a body portion formed of fused quartz and end portions formed out of fused quartz, combined with potassium."

The object in using the potassium in the end portions is to form glass into which platinum wire can be sealed in the usual manner.

In connection with the above patents it is interesting to note that the application for the United States patent, issued to Richard Küch, of Hanau, Germany, on April 7, 1908, was filed

on Dec. 7, 1905. As noted in our issue for May 2, 1908, this patent described the phenomena in mercury-vapor lamps operated at high temperatures. Considerable information concerning the Küch lamp was given in our issue for Oct. 19, 1907.

CURRENT NEWS AND NOTES.

TUNED WIRELESS.—According to a newspaper dispatch, the naval wireless station at Washington recently was transmitting and receiving from four separate sets of apparatus in communication with the battleship fleet, the various instruments being differently tuned.

EMPLOYEES SHAREHOLDERS IN MACKAY COMPANIES.—According to the recent annual report of the Mackay Companies the employees of the Commercial Cable and Postal Telegraph & Cable Companies hold shares in the Mackay Companies to the value of $2,000,000.

UNIVERSITY OF VIRGINIA ENGINEERING SCHOOL.—The University of Virginia has succeeded in raising the fund of $500,000 necessary to secure a similar sum from Mr. Andrew Carnegie. Part of the donation of the latter will become a permanent endowment fund of an engineering school.

SECRETARY NEWBERRY ON STATIC WIRELESS.—According to a newspaper interview with Secretary of Navy Newberry, that gentleman ascribed the failure of wireless communication with the returning battleship fleet to the atmosphere being surcharged by amateurs "with static electricity, which prevents wireless communication."

RAT SHUTS DOWN CENTRAL STATION.—The generating plant of the Fall Mountain Electric Light & Power Company, at Bellows Falls, Vt., was recently caused to suspend operations during lighting hours by a rat. The main fuse at the station blew, and after a search as to the cause it was found that a large rat in running across an oil-switch had been electrocuted; and his body becoming carbonized, had formed a short circuit on the mains.

REMOTE MOTOR CONTROL.—Mr. Charles A. Dresser, superintendent, Kohler Brothers, addressed the noonday meeting of the Chicago Electric Club on Feb. 17 on the subject of "Remote Motor Control." He spoke briefly, taking up the old hand-control methods and concluding with a statement of some of the advantages of modern remote-control methods which take the rate of acceleration entirely out of the hands of the operator and regulate it automatically.

WIRELESS TELEPHONE ON BATTLESHIP CRUISE.—Recent reports from Washington that the wireless telephones installed prior to the departure of the battleship fleet on its cruise around the world were a failure, are contradicted by the accounts of their working given by newspaper correspondents with the fleet. One of these writes the telephones more than met the expectations of the officers, though they could not be used when the wireless telegraph held the air.

COMPULSORY WIRELESS.—The Burke bill for the compulsory use of the wireless telegraph on various classes of vessels carrying passengers has passed the House of Representatives. The bill is meeting with some opposition in the Senate, and may not be reported out of committee. Mr. E. T. Chamberlain, Commissioner of Navigation, has urged its amendment by requiring all companies to exchange messages in time of distress or emergency, and a representative of coastwise steamship companies argued for a provision preventing the formation of a wireless combination.

LECTURES ON WIRELESS TELEPHONE AND TELEGRAPH SYSTEMS.—Mr. Theodore I. Jones, of the United Electric Light & Power Company of New York City, will lecture for the Department of Education in Public School No. 152, Avenue G, between East Twenty-third and East Twenty-fourth Streets, Brooklyn, on Thursday evening, Feb. 25, on wireless telephone and telegraph systems. Mr. Jones will discuss the principles underlying the wireless transmission of electromagnetic waves for the transmission of speech, telegraph signals and electrical energy. Wireless apparatus will be shown in operation and stereopticon views will illustrate the lecture.

AMERICAN INVENTION REVOKED IN GREAT BRITAIN.—The British government has revoked a patent covering an American invention for the production of a lock-stitch sewing machine "capable of operating at a very high speed with smoothness, ease, and but little noise, upon either thick or thin work." The grounds of revocation were that the machines as imported in Great Britain have hitherto been wholly manufactured in the United States, and since the new patents act came into force the patentees have taken no steps to comply with the compulsory working clause under which their patent is now revoked. The patentees have to pay the applicants for revocation 40 guineas in respect of costs.

MUNICIPAL PLANT TO BE SOLD.—The courts have sustained an ordinance providing for the sale of the municipal gas, electric and pumping plant of Fairfield, Ia. The purchase is made under stipulated prices of water and light. The machinery at the pumping station is to be turned over to the private concern completely, but the poles and wires are to be returned on demand in as good condition as they were received. The price to be paid the private company is considerably less than the present cost to the city, and it is further claimed that the city's machinery is so nearly worn out that $50,000 must be expended soon to replace part of it. The private company expects to make these improvements at once.

TELEPHONIC SECRECY.—Two bills have been introduced in the Ohio Legislature here making it unlawful for anyone to eavesdrop during a conversation over a telephone, tap telephone wires, repeat a conversation heard over a telephone wire or interfere in any other way with the service. Some crudities have been found in the bills as presented, and it is possible that a new bill will be drafted and the main features of both included in it. As they now stand no one would be able to use another's telephone without committing a crime. The principles of the bills are favored by most of the members of the Legislature, it is said, on account of the complaints that have been made from time to time regarding the interference with telephone lines.

CHAMBERLAIN LIBRARY SALE.—The library of the late Mr. J. Chester Chamberlain, to which reference was made in a previous issue, was sold last week by the Anderson Auction Company. The 882 items catalogued brought $32,000. As stated previously, the collection represented solely first editions relating to 10 American authors. A volume containing several poems by Edgar Allen Poe, which was a presentation copy from the author's sister, brought $2,900. A copy of the "New England Tragedy," in prose, by Longfellow, of which there is said to be only one other copy, was sold for $2,200. A copy of "New England's Masterkey," by Holmes, which was one of six copies printed, brought $750, and the same author's own copy of another work was sold for $745. The first edition of Hawthorne's "Fanshawe" brought $500. A collection of 500 letters and 37 postal cards written by Longfellow to an intimate friend brought the highest price of the sale—$5,100. One of the reasons for the high prices obtained at the sale was the condition of the books, most of which were handsomely bound, but in such a manner as to preserve the original covers. The collection sold was only part of the library of Mr. Chamberlain.

Combination Stations in the Rochester System.

IN THE bottom of the gorge below the Upper Falls of the Genesee River and on the left bank is located Station No. 2 of the Rochester Railway & Light Company. This station is reached by a passage leading from Brown's Race, on the street level, 75 ft. above, and much of the approach is hewn out of the solid rock. Station No. 2 is a combination generating plant, containing both steam- and water-driven units, the former being

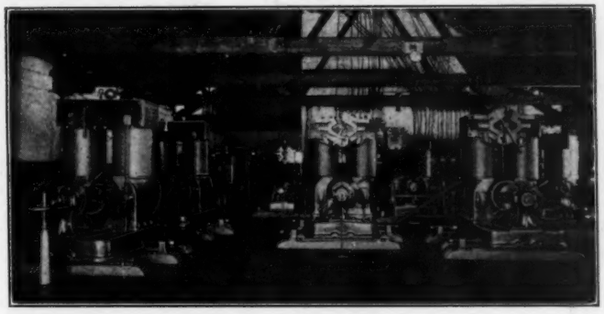


FIG. 1.—WATER-DRIVEN BIPOLAR MACHINES IN STATION NO. 2.

chiefly held in reserve. A penstock 6 ft. in diameter and about 200 ft. long leads from the race above down the rock passage referred to, the available head being 90 ft. Beside the penstock is an iron chute leading from the street to the boiler room. Through this chute the boiler room receives its supply of coal.

The station is of substantial construction, and houses the following equipment: Seven Leffel turbines, each rated at 450 hp and belted to shafting to which are connected 1800 kw in Edison bipolar machines. Three 500-hp Couty engines are belted to a line shaft, to which 800 kw in Edison bipolar machines are connected. To this same shaft are connected three of the water-wheels, so that normally the generators are turbine driven, and under low water conditions they are steam driven. Besides the three engines mentioned there are 11 other engines belted direct to 20 Edison bipolar machines. Six of the

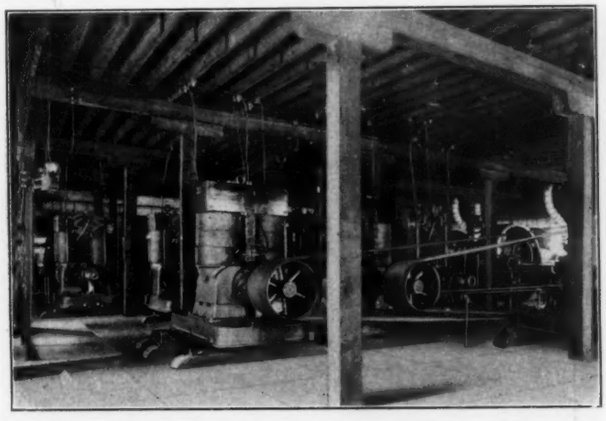


FIG. 2.—EDISON BIPOLARS USED FOR PEAK LOADS, STATION NO. 2.

engines are of McIntosh & Seymour make; three are of the old Armington & Sims type, one was built by the Southwark Foundry & Machine Company and the other is a 500-hp Ball engine. Steam is supplied by 11 Hazelton boilers, each of which is rated at 500 hp. The boilers are hand-fired with bituminous slack coal. The engines operate condensing, Bulkley condensers situated outside of the station being used for the purpose. These receive their supply of condensing water from the penstock feeding the water-wheels.

Fig. 1 shows the water-driven machines on the upper floor of the station, and Fig. 2 shows the steam-driven units used for peak-load and low-water conditions. The generators are used to feed either into the three-wire system or into the railway system. In the latter case two 250-volt machines are connected in series. In this way the company is enabled to handle railway and lighting peak loads very economically. Fig 3 shows a view of the switchboard for the lighting circuits.

STATION NO. 6.

Station No. 6 of the Rochester system is located at South Water Street and Aqueduct, on the Johnson and Seymour Race adjoining the Erie Canal. It is a combination generator and substation, being equipped with water-wheels, transforming apparatus and storage battery. The Trump turbines, operating under a head of 16 ft., are belt connected to five 60-kw Edison bipolar machines, which feed directly into the three-wire network. It is possible by holding back the water from this station to pond considerable of it against peak-load conditions, and thus to relieve the steam-driven units as much as possible. Considerable saving is effected by this means. In the basement is also located a storage battery which is able to deliver 7200 amp at a one-hour rate into the Edison system. The battery consists of 182 chloride cells, with a 25-end-cell switch. The rotary transforming apparatus in the station consists of four 500-kw, 250-volt, two-unit General Electric motor-generator sets; one 500-kw, 125-volt, three-unit Stanley set, and a 90-kw, three-unit set of the same make and voltage. The stationary transforming apparatus comprises 10 71-kw constant-current transformers for the alternating-current series street-lighting circuits. As is the case with the other stations of the company containing constant-current transformers, each transformer has its own panel mounted in front of it, and the lightning arresters on the wall back of it. No attempt is made to have a board for transferring the arc circuits.

As was pointed out in a previous article, all of the energy received over the Niagara transmission lines in the transformer station is distributed in Rochester through Station No. 6; the two 11,000-volt lines to Station No. 5 pass through Station No. 6, one directly and the other by way of Station No. 1. Fig. 5 shows a view of the transforming apparatus installed for handling the high-tension circuits. Four 550-kw, single-phase, 25-

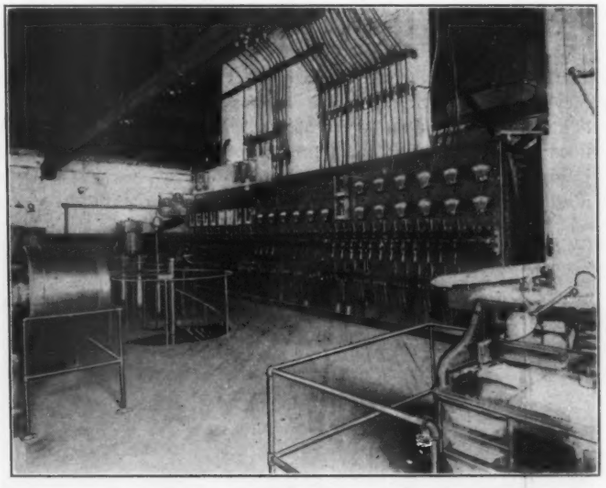


FIG. 3.—SWITCHBOARD FOR EDISON SYSTEM, STATION NO. 2.

cycle oil- and water-cooled transformers step down the voltage from 11,000 volts to 390 volts, at which tension the energy is fed to a six-phase rotary converter feeding into the railway system. One of the transformers is used as a spare unit. The rotary converter is provided with a special arrangement of potential regulator and contact-making ammeter, so adjusted that a constant load is kept on the unit. The ammeter has relays on either side which control the circuit of the regulator. The latter is fitted with a larger motor than is ordinarily the case, so as to insure quick and reliable operation. Although the scheme has worked well in keeping down the peaks on which the company is penalized, a different arrangement will be used

in the future. This will comprise a motor-generator set having a 60-cycle generator and a 25-cycle motor, with an automatic slip regulator of such a nature as to keep the load taken by the set from the 25-cycle system a constant. In this way the power taken from the Niagara lines will be automatically regulated.

Station No. 4. There is thus available in the station 125-volt, 250-volt and 500-volt direct current, besides high-tension, medium-tension and low-tension alternating current.

Just above the station is a small concrete building housing a centrifugal pump direct-connected to a 275-hp induction motor.

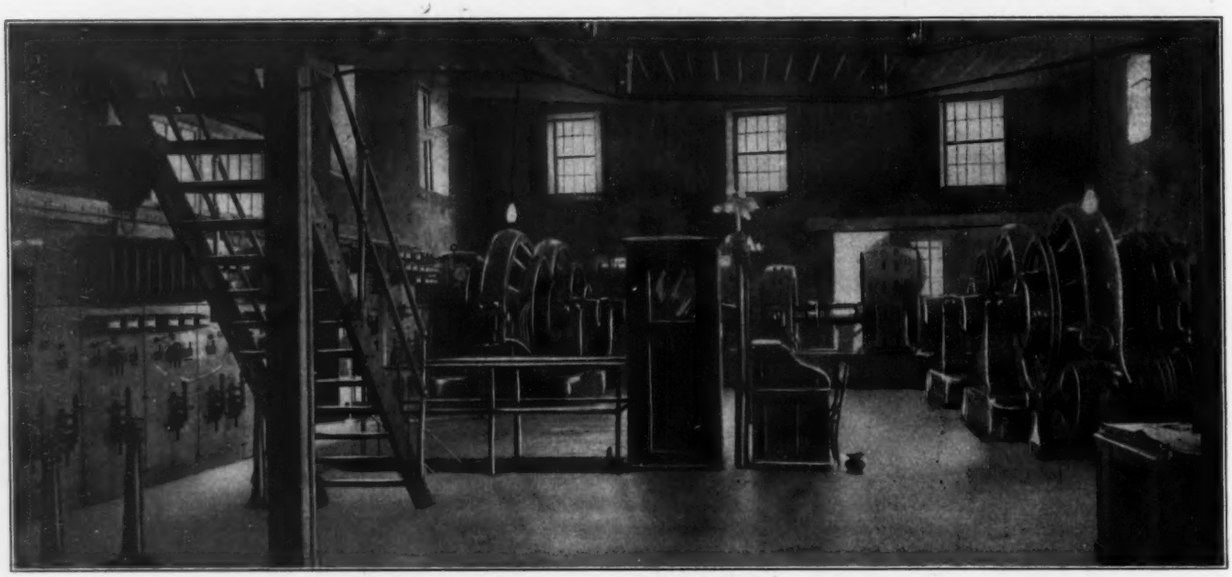


FIG. 4.—MOTOR-GENERATOR SETS FOR LIGHTING AND RAILWAY SERVICE.

The company contemplates installing such a set shortly. A general view of the motor-generator sets in the station is shown in Fig. 4.

These units are wired so that all of them can be run in series on the railway circuits when the load on the lighting system is not heavy. Switches are provided on the machines for this purpose, so that current at 500 volts does not go to the lighting board. The possibility of throwing a 500-volt current on the lighting circuits by mistake is thus eliminated.

A view of the racks and some of the outgoing feeders is shown in Fig. 6. The latter pass overhead, crossing the Erie Canal aqueduct over the Genesee River to Court Street, whence they pass underground to the various cable boxes feeding the lighting circuits in the southeastern section of the city. Heavy lines run underground from the station in a northerly direction joining the network for the three-wire system coming from Stations No. 4 and No. 2. Besides the high-tension lines already

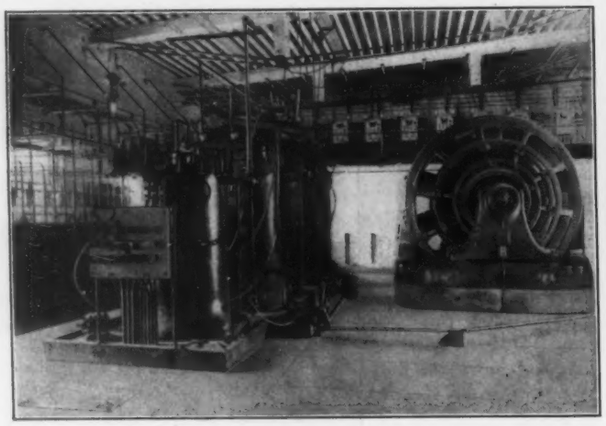


FIG. 5.—HIGH-TENSION TRANSFORMERS AND ROTARY CONVERTER.

referred to in connection with the transmitted energy from Niagara Falls, Station No. 6 is connected to Station No. 3 and Station No. 5 by alternating-current tie lines, and also with a station at Despatch, N. Y. Tie lines for railway circuits and also for the Edison three-wire circuits connect the station with

This outfit is capable of pumping 3,000,000 gal. of water daily into the Holly system, as it is called, of the Rochester waterworks. The energy for the motor is received from Station No. 6.

On the roof of the generating station is a large electric sign representing a woman cooking on a gas range. It would appear that inasmuch as the company controls the railway, electric light

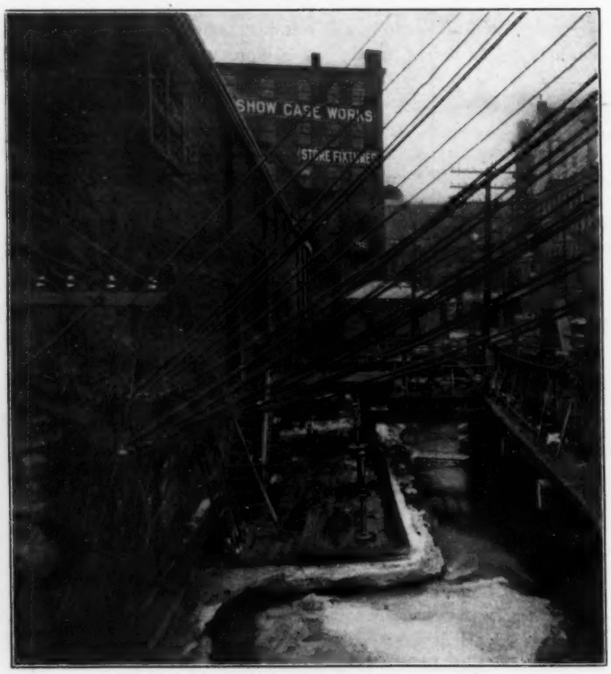


FIG. 6.—RACK AND OUTGOING FEEDERS.

and gas companies there must necessarily be friction at times between the various departments. Such, however, is not the case, and this absence of friction is the secret of the phenomenal success of the railway, the electric and the gas departments at Rochester.

Electric Suspension Railways for Handling Coal and Coke.

By F. A. Talbot.

SEVERAL important developments in the handling of coal and coke have recently been effected in Germany for securing a saving in labor, as well as economy in working cost and expedition in transporation between the various points of manufacturing plants. Hitherto mechanically driven suspension railways have been extensively adopted for such operations

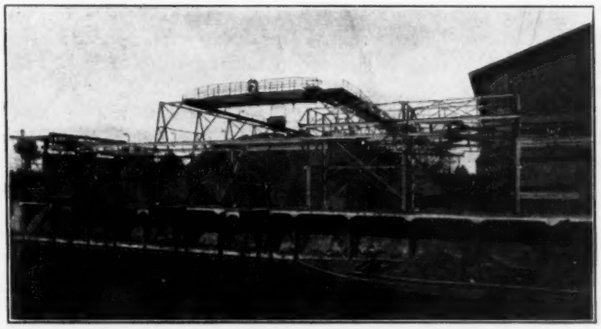


FIG. 1.—ELECTRIC SUSPENSION RAILWAY FOR HAULING COAL.

owing to their simplicity, flexibility in dealing with changes of level combined with efficiency and low cost of installation and operation. It was found, however, in a complex installation covering a small area involving numerous junctions and cross-overs, together with short lengths of side-tracks, that certain disadvantages exist, the greatest of which is in connection with the short sections, the cars upon which have to be pushed by hand on to the main tracks in order to avoid undue intricacy of the system. By the electric suspension railway these drawbacks are overcome.

In the accompanying illustrations are shown plants lately erected by a Leipzig engineering firm that has made a special study of this transportation problem, at the Duisburg Municipal and Hamburg-Barmbeck gas works respectively. In the first-named installation the coal is delivered to the works from a steam railroad sidetrack which runs through the shed. The coal is collected and distributed by an electric suspension railway comprising a number of parallel lines attached to the roof of the building. One of these lines runs above the surface railroad track so that the car buckets thereof can be lowered into the railroad cars by means of the electric winch attached to the carriage of the car, the lowering and hoisting of which is effected automatically by a motor-driven hoist mounted on the bucket. This motor carries two hoisting drums, one on either side at right angles to the track, the object being to secure a uniform strain on the car and the avoidance of side pressure on the overhead track rail. The hoisting motor collects energy from an overhead conductor, and its motions are automatically conducted together with steering and tipping by special devices. This system has a capacity of from 20 to 30 tons per hour, to carry out which only four cars are necessary, although extra buckets are provided so that one can be filled in the railroad car while the others are traveling. When an empty car returns it is lowered by the winch, detached, and a loaded one attached, so that the minimum of delay occurs at the loading point. All the electric suspension railway lines are connected together by switches so that coal can be discharged at any desired spot in the storage shed by the Bleichert remote-control and steering system, from a central point. The lines are even carried into the angle formed by the converging side walls of the shed, with the result that the entire space can be served mechanically. This would scarcely be practicable with any other mechanical means of conveyance without very complicated arrangements. The coal is stored to a height of some 13 ft. In addition to stacking the coal the railway serves to convey it to the crushers near the retort house, either from the railway direct, or from any point of the storage shed, as the buckets can be automatically lowered and filled at any point of the track.

The plant erected at the Hamburg-Barmbeck gas works is more extensive and in fact is one of the largest of this type that has yet been laid out. Here there are three distinct plants, two for coal and one for dealing with coke. The latter has been in operation for some time past and proved so economical and efficient that the same system was adopted for the two coal lines.

The coke line is used to carry that reduced product from the preparation plant to the main dumps, or to load it into boats moored alongside the adjacent wharves, in addition to which there is a tipping point in front of the retort house. In passing from the preparation plant the line has to negotiate several sharp curves along the canal bank to the main dump. Here, owing to the buckets being discharged from a considerably higher level than the line in front of the retort house, a section of 5 per cent grade 330 ft. in length had to be introduced. Generally speaking, a heavier grade than this is not permissible upon electric suspension railways, since driving efficiency is dependent upon friction between wheel and rail. The line runs on either side of the coke dump and the space between is spanned by a traveling bridge carrying a section of suspended track, the ends of which on either side project with planed tongues beyond the fixed side lines so that the cars can be transferred from one line to the other in any position of the bridge. A detent is fitted on the bridge by means of which the cars are tipped and as the detent is made to move across the bridge, and the latter can traverse the whole length of the dump, the coke can be emptied at any point of the whole space as desired.

Having emptied their contents, the cars reach the highest point on the line and have a gradually descending grade back to the loading station. The waterside station is connected with

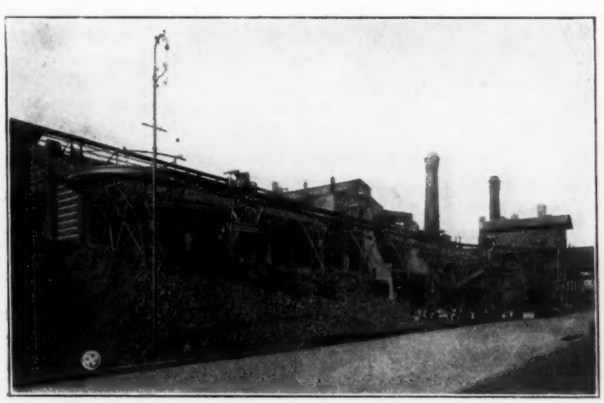


FIG. 2.—COAL LOADING STATION AND TIPPING POINT.

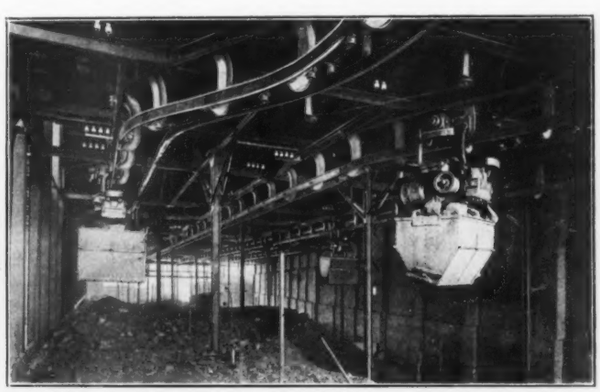


FIG. 3.—ELECTRIC SUSPENSION RAILWAY FOR HANDLING COAL.

the loading station by a special interconnecting line and at the portable chutes are placed so that the coke may be discharged from the cars direct into the boat that is being loaded. While this section of the track is in use that connecting the coke-loading station with the main dump is thrown out of action, so that there may be no unnecessary consumption of energy, and the same fact applies when the line between the preparation plant and dumps is in use.

Each of the cars has a cubical contents of 37 ft. for a load of about 780 lb. of coke, and the traveling velocity is 200 ft. per minute. The power consumption upon this basis is 0.4 kw for the empty and 0.5 kw for the loaded cars. Two workmen are sufficient for tending the installation, one at the loading hopper of the preparation plant and the other on the dump station to attend to the movements of the bridge and the release appliance for tipping the cars where required. When boats are being loaded with coke and the dump is cut out of the service this last named attendant leaves the dump station and manipulates the movements of the portable chutes on the wharf so that the loading of the vessel may be uniform.

Owing to the extremely low consumption of energy and the minimum attendance necessary to control operations the cost of working the Hamburg-Barmbeck plant is small. The following gives a representative idea of the working expenses upon the line extending between the coke preparation plant and the ship:

Consumption of energy: As one-half of the section is used for the loaded cars and the other half for the returning empty vehicles the average power consumption amounts to about 0.45 kw, and upon the basis of 500 cars per day, with a track length of 210 ft., or 650 seconds for traveling, the energy consumption approximates

$$\frac{0.45 \times 650 \times 500}{3600} = 40.6 \text{ kw-hours.}$$

As one kw-hour costs 4.5 cents the cost of energy per day is $1.827, according to which the energy consumption for 390,000 lb. (195 tons) only averages 0.9 cent per ton. To this is added the expense of two workmen at 96 cents, or $1.92, and maintenance expenses, lubricating, etc., 66 cents, making a total of $4.40, giving an inclusive working cost, less depreciation and interest on capital, of 2.25 cents per ton.

The consumption of energy on the section extending from the preparation plant to the dumps is somewhat higher, inasmuch as this track is of greater length and the gradient for a distance of about 330 ft. of 5 per cent, although the attention required is the same as already pointed out. Even in this case, however, the energy consumption cost per ton is only approximately 1.5 cents.

Each of the coal lines is loaded by three rotary cranes which lift the coal from the vessels by means of automatic grabs, discharging it into hoppers fixed within the crane frame, whence the cars of the electric suspension railway are filled. The coal line is carried at a higher level than the coke line, above which the platform is laid for the workmen engaged in loading the cars with coal. At the loading stations the cars are transferred over switches to sidetracks so as not to offer any interruption to the traffic on the main line. When the car has been filled and has started on its journey it automatically opens and runs through the switch leading on to the main track, and takes its allotted place among the train of cars on the main track. Collisions at switch points, crossovers, or junctions, or even upon the line itself, are rendered impossible by the Bleichert "block length" system which has been incorporated in such railways. In this arrangement the track is divided into a series of short lengths or blocks, only that upon which the leading car is running being alive. Consequently a regular distance is maintained between the cars, and there is no possibility of this distance being varied by succeeding cars having a lighter load. Similarly, should a car break down, all those behind are brought to a standstill upon their respective currentless blocks, so that rear collisions are impossible. This sectional working constitutes one of the greatest features of the Bleichert system. It is automatic in its action, the car coming into contact with strikers at the beginning of each block length, which opens the circuits upon the succeeding section, automatically switching it in again at the end of the length, so that the next car can follow.

After leaving the loading station the cars reach the inner track of the loop laid along the waterside, where they run on to a longitudinal section at the coal storage shed. From here they run over one of the traveling bridges on which the method of discharging the contents is the same as the coke installation, passing on to the track on the opposite end of the bridge, whence they finally return to the loading station for a fresh consignment of coal. The capacity of the whole plant is 250 tons per hour.

This installation is an excellent example of how the many transportation problems can be successfully solved by the employment of an electric suspension railway. The traffic on the coal line, for instance, could not be handled at all by any less comprehensive system. Without this electrical plant a combination of various means of transportation would have had to be adopted, which would not only have entailed a heavier initial outlay, but would have involved greater operating expenditure and considerable depreciation of the material owing to transshipment.

Auto-Transformers versus Rheostats for Induction Motor Starters.

By I. E. Hanssen.*

Ever since its introduction the so-called auto-starter has generally been considered the only satisfactory device known for starting induction motors of the type having a squirrel-cage rotor winding. Of late, however, considerable attention has been given to the use of rheostatic starters, and it is the purpose of this article to discuss briefly some of the relative advantages and disadvantages of the two types.

The object of the starter is to reduce the voltage impressed upon the motor in order to prevent excessive current. The auto-starter accomplishes this result without introducing large losses, because the voltage is reduced through transformer action. When a rheostatic starter is used the case is different, because the reduction in voltage represents loss of power. As the e.m.f. across the resistance is out of phase with that of the motor terminals, the former is greater than that shown by the algebraic difference between the line e.m.f. and the motor e.m.f. and the losses are also correspondingly greater.

For large motors of the type in question, although they are seldom called upon to deliver a starting torque exceeding one-half full-load torque, the total power required in starting would nearly always be too great to be handled successfully by the prime mover if a rheostatic starter were used.

For the same reason, so far as the effect upon the regulation of the prime mover is concerned, the auto-starter is always superior to the other type.

Due to the magnetizing current and to the magnetic leakage of the auto-transformer the wattless current at the receiving end of the line will be slightly greater for the auto-starter than for the rheostatic one. The difference is very small, however, being less than 1 per cent in well-designed auto-transformers; it has a counterpart in the greater inductive drop due to the greater current when using the rheostatic starter. This remark applies particularly to large apparatus where the percentage of leakage in the auto-starter is less than for small starters. Even in small sizes it is possible to keep the magnetizing current down to from 2 per cent to 4 per cent of the motor's wattless current and, therefore, the above statements apply also for these smaller sizes. Of course, if the proper precautions are not taken, the leakage will be high and in this case the auto-starter may prove inferior to the other type. One should be careful, however, about drawing broad conclusions from a few instances which may be particularly favorable to one type or the other.

The rheostatic starter is always inferior to a well-designed auto-starter, but makes a fair showing when used:

(1) With motors having low torque and low power factor when starting.

(2) When used on circuits of relatively low resistance drop and high inductive drop and ample reserve power.

(3) With small motors.

With poorly designed auto-starters good results can, of course, not be expected, and if other conditions augment this feature, it may be found that the rheostat will give better results for small sizes; however, such a case is not one to be used as a criterion for a whole class of starters.

The fact is that, in general, for machines of any considerable size the use of rheostatic starters would be decidedly poor engineering, with few exceptions. For example, a modern 450-hp, 25-cycle, 2200-volt, three-phase motor delivering half full-load torque at starting, requires about 300 kw when an auto-starter is used, while fully four times this amount, or 3.5 times the rated motor output, is needed when a rheostatic starter is used; the line loss, line drop and drop in the generator speed would also be very considerably greater for the latter.

It has been stated by others that where relatively high starting torque is required to be delivered by a large motor, the rheostat would be nearly as good as the auto-starter. This is true if the motor voltage is very nearly equal to the line voltage, since in this case the effect of the starting device is small in either case. However, such a condition should, as a rule, be taken care of by installing a motor with a phase-wound secondary.

In general, the operating conditions are somewhat different from the above for small apparatus, particularly when operated from a circuit where variations of voltage are of no great importance. Here the extra power taken by the resistance is of no considerable moment, and it does not pay to try to keep the voltage variations very small; here is a field for rheostatic starters of low cost for sizes up to, say, 15 hp. Even here it will be necessary to use an auto-starter when a heavy starting torque is required and the line resistance is considerable. In order to meet all conditions in the most satisfactory manner it would, therefore, be necessary to provide auto-starters in stock in addition to rheostatic starters, if the latter were to be standardized for certain sizes; this fact to a certain extent nullifies the advantage of low cost.

In Table I and Table II are given the data concerning the starting conditions for two 30-hp, 25-cycle, three-phase motors. Motor No. 1 has a pull-out torque of 3.75 times its full-load torque, while motor No. 2, due to greater magnetic leakage, has a pull-out torque of only 2.8 times its full-load torque. The slip at full load is 4 per cent for each motor.

TABLE I.

Starting Torque Equals Full-load Running Torque.

	Motor No. 1			Motor No. 2		
Type of starter.	Amp. in line.	Kva. in line.	Kw. in line.	Amp. in line.	Kva. in line.	Kw. in line.
Auto-starter	101	70	33	133	92	33.5
Rheostatic-starter ..	158	110	91.6	158	110	72.5
Values: rheo ÷ auto	1.57	1.57	2.77	1.18	1.18	2.16

TABLE II.

Starting Torque Equals One-half Full-load Running Torque.

	Motor No. 1			Motor No. 2		
Type of starter.	Amp. in line.	Kva. in line.	Kw. in line.	Amp. in line.	Kva. in line.	Kw. in line.
Auto-starter	54	37.5	17.6	68.5	47.5	17.8
Rheostatic-starter ..	112	77.6	71	112	77.6	65
Values: rheo ÷ auto	2.07	2.07	4.04	1.64	1.64	3.65

An inspection of Table No. 1, which gives the conditions when the motors deliver a starting torque equal to the normal full-load torque, shows that for motor No. 1 the line current and kva are 57 per cent greater, the kw 177 per cent greater for the rheostatic starter than for the other type; for No. 2 motor, these values are 18 per cent and 116 per cent, respectively.

When exerting one-half of full-load torque the difference is still greater, the change being in favor of the auto-starter. For motor No. 1 the current and kva are more than two times and the kilowatts more than four times as great for the rheostat as for the auto-starter, while for motor No. 2 they are 1.64 and 4 times as great, respectively.

The above values show plainly that the auto-starter is much superior to the other class in regard to kva and power consumption and consequently also as to the line drop and the speed regulation of prime movers. They also show that with the rheostatic starter the current and the power required at starting are greater for the good motor than for the poorer one; that is, the better the motor the more power it requires at starting if a rheostatic starter is used, while with an auto-starter the reverse is true.

It will also be seen that there is required about twice as much power to exert one-half full-load torque when using the rheostatic starter as is necessary to develop full-load torque with the aid of the auto-starter; for motors such as No. 1 the value of the kva is greater also, although the difference is not so great as for the kilowatts. Moreover, the tables show that the greater the difference between the line e.m.f. and the e.m.f. at the motor terminals the greater is the saving due to the use of the auto-starter.

The Bearing of Modern Illumination Upon Physiological Optics.

By Sydney W. Ashe.

Helmholtz states that, when studying the effects of illumination upon the eye, one is dealing with a physiological and not a physical problem. This fact soon becomes apparent to anyone making light measurements. The writer noticed it particularly when making a number of measurements performed with a view to using the pupil of the eye as a form of photometer, the purpose being to measure its diameter when exposed to various colored lights of different intensities. The actual size of the pupil plays a very important part in our judgment of light intensities.

In connection with the above-mentioned measurements of the pupil, a large number of measurements were made upon the variation of visual acuity for lights of different intensities and of different intrinsic brightness. Other phases of the investigation have been to determine the effect upon visual acuity of foreign lights placed in the field of vision—the effect of size and shape of different letters upon one's ability to read, the effects of accommodation and of fatigue. This work is now being carried on at Columbia University by the writer in collaboration with Mr. Rice, under the co-operation of the Departments of Psychology and of Physics.

Up to the present time a large amount of work has been devoted to the development of new apparatus for making accurate measurement, the standardization of instruments, and the elimination, so far as possible, of all physical errors. All of the illuminants are supplied with energy from a storage battery, and the e.m.f. being maintained constant; a variation of e.m.f. of a few per cent, equal approximately to the width of the voltmeter needle with a 150-volt scale, introduces an error of from 3 per cent to 4 per cent—or, in other words, causes a variation in the light intensity of this amount. All values of the candle-power of the various colored illuminants have been carefully determined by means of the flicker photometer developed by the late Professor Rood.

The elimination of physiological errors has been a more difficult problem than the elimination of the physical errors; the former are eliminated only by taking a large number of readings upon various subjects and at various times. For instance, when measuring the visual acuity by means of a Snellin's chart the writer would find, after entering a dark room and beginning observations immediately, a tendency to read high; that is the ability of the observer to read a letter such as the capital R, when illuminated by an intensity of light of a given number of foot-candles, was greater at this time than when one remained in the room from 15 to 20 minutes before beginning to read. The percentage variation in the readings was about the same at all times, the effect previously mentioned being due probably to the accommodation or adaptation of the eye in the darkened room to the light intensity under test. When the process of taking observations had continued for about an hour, successive readings began to vary widely in accuracy, due to general fatigue of the eye. The fatigue is especially trying when making observations with red light.

Upon looking over several series of observations the writer was able to determine the length of time necessary to stay in

the darkened room before beginning to observe, and also how long the observations could be taken before the eye became fatigued and lost its accuracy. It is found after taking all of these precautions that a variation still exists due to a change in the physical condition of the individual. This result seems natural when it is remembered that the eyes reflect the general condition of fatigue of the body, or what is termed a feeling of sleepiness comes over one when he is bodily tired, although his eyes may not have been used at all for reading.

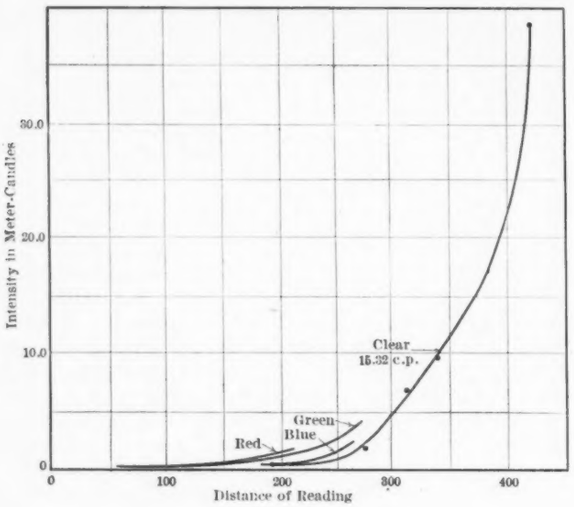


FIG. 1.—VARIATION OF VISUAL ACUITY WITH COLOR.

To eliminate so far as possible errors due to changes in the physical condition of the individual, it was necessary to take observation in the morning when the eye and body were thoroughly rested, and to take the observations about the same time each day. It was also found desirable to reverse the order of taking the observation; for instance, to use the lights in the order red, green and blue for several mornings; then blue, green and red, and red, green and blue, to determine what effect the fatigue of a particular color might have upon the visual acuity when reading with another color of illumination. The results obtained thus far are interesting, as showing a wide variation from somewhat similar tests made by Messrs. Andre Broca and F. Laporte, as reported by them in the *Bulletin de la Société Internationale des Electriciens*, June, 1908. They made a study of visual acuity, rapidity of reading, contraction of the pupil and after images, their main object being to study the effect of the intrinsic brightness of light sources especially when placed in the field of vision. Their tests were performed upon modern illuminants—namely, the carbon-filament lamp, the tantalum lamp, the tungsten lamp, the mercury-vapor lamp, the Nernst lamp, open and closed arcs, and flaming arcs. Their conclusions, which have been much quoted, are given literally as follows:

1. "The question may be asked whether industrial lights of different color, compared by means of a photometer with equal intensity would be equivalent in giving to the eye acuity of vision, ease and quickness of reading.

2. "We have just seen that the incandescent carbon lamp and the mercury arc giving the same intensity measured on the most simple possible photometer give also the same practical visual acuity.

3. "The rapidity of observation is independent of the nature of the light and also the intensity of the light, if the distance of the observer from the test is in each case the same fraction of the limited distance for reading.

4. "Our measurements show the fact which has been much discussed that the photometric measures executed with industrial and utilizable intensities determined very fully the practical value of the lights.

5. "Knowing the physiological properties of the eye and the mean limits of accommodation we recommend as a suitable intensity for work a value of from 20 lux to 40 lux.

6. "The study of the pupilary contraction shows that it is necessary to remove the luminous source from the field of peripheral vision. The contraction seems to depend more on the brightness of the luminous source than its distance. One ought therefore to recommend the use of lamps with reflectors and with globes of such dimensions that the intrinsic brightness will be relatively feeble. Indirect lighting from diffused light sources hidden from view fulfils the requirement completely.

7. "The contraction of the pupil caused by peripheral vision of the lamps is the more harmful to visual acuity as the illumination of the text is the more feeble, and this may cause in this case considerable fatigue. On the contrary it becomes less important when the intensity is from 20 lux to 40 lux. In certain cases of powerful intensity the presence of a brilliant source in the peripheral field is able to increase the visual acuity but at the cost of inadvisable fatigue.

8. "The study of the residual images on the retina leads to the recommendations already given of removing luminous sources of light as far as possible from the field of vision.

9. "The different luminous sources arrange themselves for pupilary contraction and persistence of residual images according to the order of their respective intrinsic brightness. However, the mercury arc, which had the most feeble intrinsic brightness among the lamps which we have studied, makes an important contraction of the pupil. It does not show, therefore, all of the advantages which one would have expected. When one is able to avoid the direct view of the luminous source it is absolutely indifferent from the point of view of hygiene of the eye which of the industrial lamps is chosen."

Referring to paragraph 2 of these conclusions the writer wishes to offer the curves of Fig. 1, which show the variation in the visual acuity for the writer's eyes for lights of different colors—red, blue and green. While the number of observations which have been taken are not sufficient as yet to derive the equations of the curves and establish a law for average conditions, the fact has still been apparent for all of the observations that there is a marked difference in the visual acuity or one's ability to read, depending upon the color used. All of the values of light intensity have been reduced to meter-candles by dividing the candle-power by the square of the distance of the light

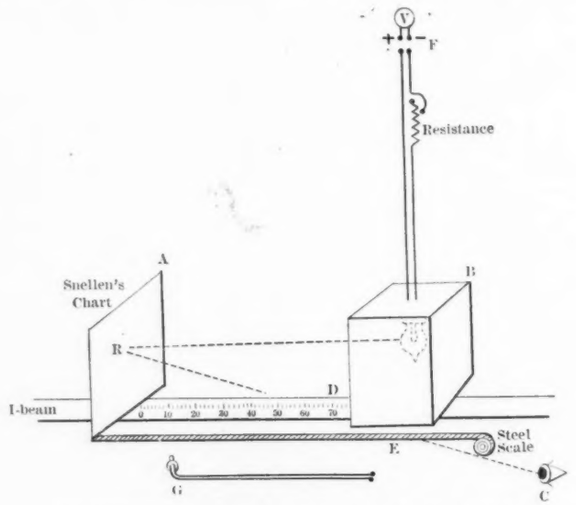


FIG. 2.—APPARATUS FOR MEASURING VISUAL ACUITY.

from the chart in meters. In Fig. 1, the reading distance is expressed in centimeters.

The manner of making the observations was as follows: Referring to Fig. 2, *A* is a Snellin's chart, the capital letter *R* on one of the lower lines being chosen for observation. The height of this letter divided by the distance from the chart at which it may be read is termed the visual acuity. Referring to Fig. 1, instead of dividing the reading distance by the height of

the letter, the curve has been plotted with distance directly as abscissae. The values, however, can be readily converted to visual acuity by using the value 0.4 cm the height of the letter *R*. At 300 cm the visual acuity is $0.4/300 = 0.01332$. This letter was used in the observations because it was more difficult to discern than the other letters in the same row, such as *N, A, D,* etc. Referring to Fig. 2 again, *B* is a lamp mounted in a box, one side of which is open so as to illuminate the chart *A*. The

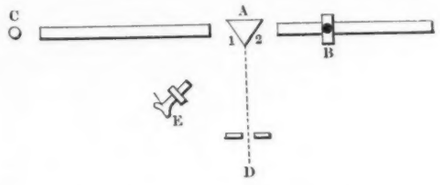


FIG. 3.—SIMPLE PHOTOMETER OF BROCA AND LAPORTE.

lamp is movable so that it may be set at a given distance along the beam *D*, which is graduated. The lamp voltage is maintained at a constant value by means of the voltmeter, adjustable resistance, and storage battery service *F*. A steel scale *E* hangs loosely, fastened at one end, at the chart, and can be brought to the eye of the observer giving the reading distance. A small lamp *G* is carried in one hand of the observer, and turned on when the observer is ready to read the steel scale. By this method one observer may make observations singly. Fig. 1 shows a series of observations taken in this manner. While the relative position of these curves seems to shift slightly from day to day—depending, as previously stated, upon the physical condition of the individual—nevertheless there is always a decided difference in the visual acuity for different colored illuminants of the same meter-candle intensity. The reason why Messrs. Broca and Laporte could not appreciate this difference in the visual acuity may possibly be explained in the manner in which their observations were made.

The simple apparatus which they used for studying visual acuity is illustrated in Fig. 3. This apparatus consists of a wedge of wood *A*, upon one side of which, 1, is pasted a small Snellin's chart, upon the other face is pasted a white card cut from the same material as the chart. On one side, *B*, is placed a standard lamp at a fixed distance, and at the end of *C* is placed a movable lamp under test. The eye of the observer is placed at the opening *D*, the eye looking at both sides of the wedge, and the movable lamp is so placed that the illuminations on both sides of the wedge are the same. The eye is then shifted to a small telescope *E*, which is moved back and forth until the letters on the face of the Snellin's chart had been read. If the authors had used a flicker photometer to determine the relative intensities of the lights of different color, no doubt this difference, due to a difference in the color effect, would have been appreciated. In other words, they have argued in a circle.

The following method has been used by the writer and his associates to study the contraction of the pupil:

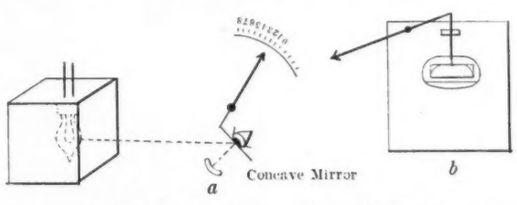


FIG. 4.—APPARATUS FOR MEASURING DIAMETER OF PUPIL.

The arrangement for illuminating the lamp and adjusting it was the one used in the previous experiments on visual acuity. For the Snellin's chart was substituted a support with an opening in it, as shown in Fig. 4; across this opening are mounted two cross-hairs, one of which is fixed and the other movable, being connected to a stirrup, as shown in Fig. 4 at *b*. The distance between the cross-hairs is magnified by means of a simple lever, as shown in *b*. The size of the pupil can thus be measured very accurately. The observer looks through the opening into a small concave mirror with a radius of curvature of 2 in., adjusts the cross-hairs and takes the reading, the eye being so placed that it almost coincides with the cross-hairs. While it is true that the size of the pupil as thus determined is slightly refracted, due to the cornea, the percentage of error is about the same with all observations and is therefore satisfactory for comparative work.

Fig. 5 shows a series of observations taken upon the pupil with two sources of light, a green lamp and an ordinary 16-cp lamp placed at such distances that their intensities on the eye were equal. The lamps were then placed at different angles in the field of vision, namely 0 deg. to 30 deg., 50 deg. to 75 deg. The readings were as follows:

Green lamp:		
30 deg.	4.03	m.m.s.
50 deg.	4.25	m.m.s.
75 deg.	4.75	m.m.s.
Carbon lamp:		
0 deg.	3.90	m.m.s.
15 deg.	4.03	m.m.s.
30 deg.	4.51	m.m.s.
50 deg.	4.85	m.m.s.
75 deg.	5.32	m.m.s.

These results were the averages of a number of readings. It will be noticed from these readings that, as a lamp is brought into the field of vision, the angle becoming shorter and shorter, the pupil of the eye contracts more and more. Although no image of the lamp is formed on the fovea of the eye except

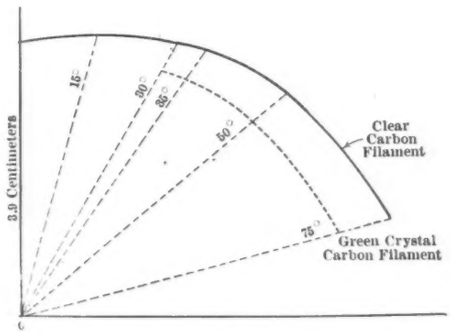


FIG. 5.—CURVE SHOWING SIZE OF PUPIL WHEN EXPOSED TO ILLUMINANT AT VARIOUS ANGLES IN VISUAL FIELD.

when the light is at zero, it will be noticed that the pupil contracts gradually as the lamp is brought into the field of vision, and that the contraction is greater for the green than for the approximately white light of the carbon filament, the light containing nearly all rays of the upper part of the spectrum. The effect of the lamp in the field of vision may be likened to a camera which is so placed that the sun shines into the lens from an angle. A photograph taken in this manner will be "light struck." There is no sharpness, only outlines more or less indistinct. The pupil of the eye contracts, however, tending thereby to lessen the amount of light which enters the eye; but even with this there is an excess of light flux impinged upon the retina to one side of the fovea. Upon the fovea is focused by the accommodation of the lens the image of the letter which one is attempting to read, but the sharpness of this image is probably affected by the excess of light flux on the retina, by the foreign lamp in the field of vision. The writer has found that the presence of a foreign lamp in the field or vision decreases one's ability to read by approximately 30 per cent for an ordinary 16-cp carbon incandescent lamp. The effect would probably be more marked if the intensity of the light were greater.

The curve sheet of Fig. 5 is interesting in view of the modern theory of color perception based upon the number and location of rods and cones over the retina. If there is practically no color perception outside of the fovea one would imagine that the size of the pupil would be the same at a given angle irrespective of the color, but experiment seems to point to the opposite effect, as indicated by the curves.

Electrical Equipment of the Bergenport Chemical Works.

By Warren H. Miller,
Electrical Engineer, Standard Oil Refineries.

THERE are two features of the Bergenport Chemical Works that may be of interest to the electrical fraternity: the size of the installation units compared to the majority of alternating-current plants, and the acid corrosive problems encountered in the atmosphere of a chemical works.

The entire plant had to be put up and operated in an atmosphere so heavily charged with sulphuric acid vapors that when a 1-in. rope is left out over night it is unsafe for use on the following morning. No metal or conduit whatever can be used anywhere, marine fittings are useless because all of them contain more or less exposed metal, and lead cable has proved, in the light of practical experience with lead about acid plants, to be the most hopeless of all.

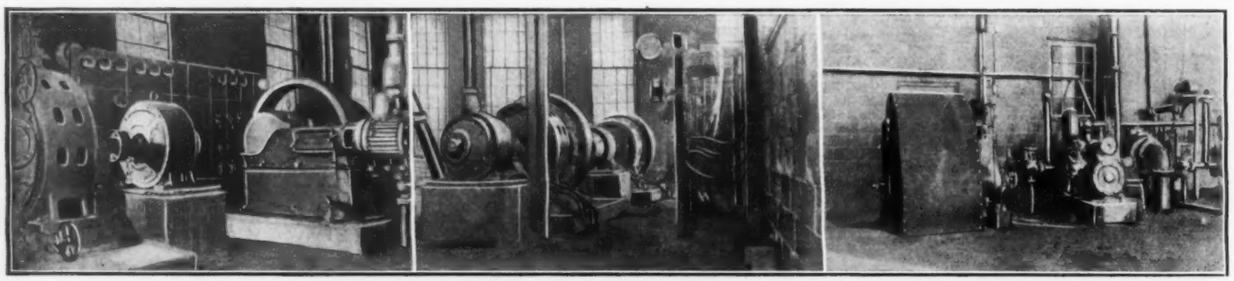
The plant belongs to the Standard Oil Company, and is one of the largest chemical works in the world, producing nearly 300 tons of sulphuric acid per day of 24 hours. It uses the "chamber acid" process, which renders the conditions a little more severe than ordinary, but the same problems are encountered in any chemical works where acid vapors abound.

Sulphuric acid, being a most excellent conductor of electricity, and a corrosive of every known metal, including lead, makes fires from electric "grounds" an absolute certainty sooner or later unless the electric distribution is designed to obviate its effects from the start. In plants reeking with acid vapors, dangerous corrosion is only a matter of weeks, but even in plants where the effects are not very noticeable, the same corrosion to dangerous grounds is sure to occur within at most a few years' time.

As all of the soil of a large acid plant is virtually one vast acid-soaked sponge containing acid salts in all degrees of formation, an underground conduit is by no means a haven of rest from the ever-present vapors. One of the most successful conduits ever put down was a wooden trough in which the feeders and mains were laid, the whole being filled with boiling tar which hardened on cooling. The acid promptly ate away the wooden trough, but stopped at the surface of the solid block of tar which contained the wires. While the tar proved to be completely acid-proof, much difficulty was had in tapping the wires so as to make an acid-proof junction.

The cheapest and most flexible system of distribution about a chemical plant for all outside work is plain triple-braid, weatherproof wire on poles, all of the wire being throughly tarred as soon as put up. The balata gum insulation of this wire is quite resistive to acid, whereas any form of rubber covering would be entirely inadmissible because of the vulcanizing effects which quickly become manifest. Lead-covered wire, which seems at first sight to be the panacea for all acid ills, was not seriously considered for an instant. Long experience with lead work for protecting iron has taught acid men that, no matter how thick the sheet is, no permanent protection can be relied upon. All acid plants are full of iron bars, rods and plates, lead covered with all the care that experienced lead-burners could give to the work, yet these within a very few years became so badly "sulphated" as to require stripping the lead off entirely and re-covering. As soon as the bar is put up, the acid vapors condense on it and immediately find their way down to the iron through tiny pores and infinitesimal fissures caused by the stretching effect of manufacturing the sheet lead and by minute particles of impurities. Forthwith begins that insidious process known as "sulphating." A double salt of iron and lead is formed in the fissure which lifts the lead, exposing more iron to the acid, which in its turn becomes sulphated until in time the entire rod is virtually a bag of lead containing an iron core surrounded with sulphate. The entire process sometimes takes place in as short a time as six months. The mechanical strength of this sulphating action is almost inconceivable. The writer has seen steel acid towers weighing over 170 tons lifted inches above their foundations by sulphate formations between their column bearing plates and the lead work covering the foundations. The sulphate is far more bulky than the metal used to form the basic radical and it exerts as much force in finding room for this bulk as a metal rod will on expanding under heat.

When one reflects that these troubles occur within a few years with heavy sheet lead protection, he will understand how much greater is the danger from using lead-covered wires where the lead is only 1/32-in. thick and so full of pinholes from the process of drawing that the manufacturers will not guarantee it for submarine service unless armored with iron. Such a case in point was that of a twin wire cable run under 4-ft. of fresh water crossing a 70-ft. race. This cable developed a weak ground connection in the first month of service, showed a full ground on the voltmeter the second month and passed ¼ amp of current on 500 volts in the third month, whereupon it was taken up and replaced by overhead work. The grounding was due to minute pinholes inherent in the lead itself, which metal is non-ductile to a degree and apt to become granular in the process of drawing.



FIGS. 1, 2 AND 3.—ALTERNATORS, EXCITERS, SWITCHBOARD, FAN AND PUMPS.

Tar, on the other hand, is impervious to acids and a good coat of it on weatherproof wire renders a conductor proof against grounds and safe for splicing. It is best put up with poles and standard glass insulators so as to be eaily reached and always in plain sight. Junction fuse boxes are of the cast-iron, weatherproof, iron-clad type, well tarred and provided with brass thumb-screws, as iron threads quickly rust solid. All splices are covered with rubber tape which in its turn is given a single thickness of ordinary friction tape and the whole splice is well tarred.

Entrances to the buildings throughout the plant were effected by means of the usual drip loops and porcelain tubes. The entrance switches used were porcelain base combination switches and cut-outs. Slate bases are not advisable, being readily attacked by acid fumes. Many of these switches were placed outside in "Transite" asbestos board boxes on the poles. The layout of the buildings was such that many lines could be run along the parapet walls on the 4-in. x 4-in. hard yellow pine poles shown in the illustration.

In arranging the distributing circuits, the "closet" system was adopted for the lamps principally because it kept all heavy mains on the outside of the buildings where they would be in the least danger from grounds. Taps were taken off at the various locations for the lamps, spaced as nearly as possible to

balance the two sides of the closet system. The position of the building gives a good illustration of the maxim that where the lamp center is a geometrical point, the "star" system is best to use; but where it lies in a line such as a circle, the "closet" gives the better distribution.

The interior wiring problem held just one consideration, namely, that absolutely no metal must be exposed to the action of acid fumes. Such an object as the ordinary steel conduit outlet box, for instance, would simply prove a nest for the formation of sulphate. Separate lead-covered wires to be run on cleat work were considered for a time. If the wire were well tarred, pinhole troubles would be obviated, but every single tap meant a place where exposed copper and lead would be perilously near each other in the presence of a highly conductive acid condensation. The solution adopted was the use of hard yellow pine molding painted with asbestos and tarred both inside and out, with Fielding molding receptacles for outlets. The molding was first put up with neat miter joints and then painted with thick tar that filled the grooves. Weatherproofed wire was then buried in the tarred grooves and the molding was given another coat of tar. While still wet the cap was secured by twopenny copper nails spaced 2 ft. apart and the cap was then tarred. Thus there was obtained a solid tar cable impervious to acid and moisture. Wherever a lamp was wanted the cap was sawed and a porcelain molding receptacle was put on, raising the wires out of the tar with the screw-driver and baring them where they passed under the receptacle screws. With the porcelain cap screwed down and the lamp in place, there was still a narrow annular space between the lamp and the receptacle. The simplest seal for this proved to be a ring of No. 14 weatherproofed wire tarred and slipped on the lamp before screwing it in place. This wire filled the space and made an effective seal. Thus nothing was exposed to the acid fumes but glass, porcelain and tarred molding. It may be mentioned in passing that in a later installation at the acid-restoring plant of the Bay Way refinery the writer used tungsten lamps and found that the same seal could be had with insulated telephone wire, though weatherproofed wire was too thick to allow the lamp to seat because of the large brass shoulder on the tungsten lamps.

No arc lamps of any description could be used, as it is impossible to keep the metal cases from corrosion for any great length of time, but by forming clusters with bars of six receptacles spaced a few inches apart on the molding and fitted with a cut-out, more than 40 arc lamps were displaced—before the day of the tungsten lamp. For all motor leads use was made of three-wire molding led into yellow pine Transite-lined cabinets. The switches were then closed, the fuses put in place and all metal work was tarred.

The equipment contemplated electric drive for six lead acid fans, two elevators, a rotary dust burner and a machine shop and a carpenter shop. The motors had to be protected against red iron oxide dust from burnt pyrites ore in addition to the acid fumes. The oxide is another excellent electric conductor. Whenever one touches a beam a shower of it sifts downward. This dust would surely ground the commutator leads and collect on the brush contacts of a "dustproof" direct-current machine and cause sparking. However, an induction motor will run when covered deep with it without the slightest danger from grounds, which fact virtually dictated the adoption of alternating current for the entire system. It is easy to get first-class marine, water-tight, direct-current motors, but it is difficult to keep them so when the electrician has to break the joint periodically to reach the commutator. In a few months the motor cover is without a gasket, being screwed down by hand while the armature is packed with dust. Men are only human, and in a great company one must reckon with the personal element of things quite as much as with the engineering possibilities.

As the installation was to be one of mixed lamps and motors receiving energy from the same busbars, the elevator motors injected their little idiosyncrasies into the situation. The elevators were two-ton, belt-driven units and required about 7½-hp motors. As the whole generator equipment would not require more than two 50-kw machines, the effect of starting and stopping the elevators would be felt on the lamps, besides which there would be the inevitable and interminable controller troubles with which to contend. Works managers do not have to be reminded of the legion of times when "that elevator" was out of commission "because there was something the matter with the controller." The reasons therefor are simple and patent:

There are only two kinds of operators who handle shop elevators. One is the husky stock wrangler or cupola tender who lays violent hands on it and takes all the notches at one whirl; the other is that old man who inches the controller around, bit by bit, until he sees something moving. There he leaves it—with a bare contact on two fingers and the other finger just at the arcing point. The only way to circumvent these two individuals is to provide a belt-driven shop elevator which owes its risings and settings to the movement of a wire rope shifter. This can be pulled, yanked or otherwise maltreated without causing anything in particular to happen, and shop managers have long recognized it as the one form of elevator control possessing the necessary longevity and hardihood.

At the Bergenport Chemical Works the belted elevators were operated by foreigners and run by steam engines on friction load unless hoisting or lowering the elevator. The engines were replaced by simple induction motors, and to avoid any rush of current with consequent drop in voltage on throwing the elevator hoist into action, a flywheel was put on each motor. This wheel was about 27 in. in diameter, with a 3-in. x 4-in. rim and ⅞-in. web, and weighed about 300 lb. The energy stored in it at 1200 r.p.m. was great. It was quite feasible to disconnect the motor entirely when the elevator was half-way up, whereupon the flywheel would run the entire load up to the top without appreciably losing speed. It proved the best "controller" ever invented. The writer had often used the same device in motors driving air-compressors, bulldozers, bar shears and other intermittent tools, but did not expect such good results with elevators. The actual data are as follows: Hoist, 2 tons; lift, 18 ft.; motors, 7.5-hp Westinghouse, three-phase, 60-cycle, squirrel-cage induction. Full load, 5 kw; friction load, ½ kw; drop in voltage on line, 8 volts momentary fluctuation returning to normal. This on the 220-volt system caused no noticeable drop in the lamp brilliancy. A similar elevator at a Philadelphia refinery requires a 10-hp motor without a flywheel as there is no stored energy available.

On the acid fan loads the induction motors proved capable and efficient, replacing steam engines that had run for 20 years day and night with only sufficient stoppage to take up the brasses. The motors required practically no attention from the day they were set running. Where the vapor of the running room was heavily acid-laden, the fan action of the rotor caused trouble from blowing acid vapor over the stator coils, thereby "grounding" them. This trouble was remedied by making lead kidneys to fit the inlet openings in the end frames and plugging all of them up but one, into which was led a 2-in. lead pipe which connected the motor with the comparatively clean outside air. To avoid ultimate trouble from sulphating, the laminations of all the motors, the stator cores and the squirrel cages of the rotors were tarred up solid, leaving clearance merely in the air-gap. As thus installed the motors last indefinitely and give no more trouble than so much mill shafting.

The power-house installation differs from standard installations only in that the alternators were the first of their kind ever built. They were two 50-kw, engine-type, Westinghouse, 220-volt, three-phase, 60-cycle alternators directly connected to two Harrisburg simple non-condensing engines. The exciters were directly connected to the stub end of the engine shaft by a suitable shaft coupling. They were totally enclosed and "dustproof," which matter was a piece of polite fiction. These exciters gave the only operating trouble of the entire installation, running so hot at full load that the covers had to be taken off. The rest of the generating station required no attention

beyond an occasional supervision by the head fireman in charge of the works boiler plant adjoining. At regular intervals the electrician of the works visits the installation to examine the bearings and the switchboard instruments. At night the electrical plant is headquarters for the works foreman, who had been drilled previously in the operations of running the generators. About the only precaution necessary with the generators to meet acid works conditions was to tar thoroughly the rotor and stator coils and the laminations of the core.

The switchboard, built by the Walker Electric Company, was of green Vermont slate, black enameled. Any form of marble would promptly have been reduced to calcium sulphate by the ever-ready acid fumes, and Pennsylvania slate would soon have had its iron veins swollen with compound ferric sulphate salts, but the green Vermont slate stood the acid very well. The board was heavily shellacked on the back and all busbars and leads were taped and shellacked. With these precautions it was reasonably safe, though one could not touch it anywhere in damp weather without being shocked.

This plant has been running steadily since its erection, over a year ago, without any motor troubles whatsoever having been reported, and without materially increasing the conductance to ground. Not having any metal exposed to acid fumes, the sulphuric acid department should be in as good condition 20 years from now as at present, with the usual amount of upkeep and repair always going on in a large industrial establishment.

Third-Rail Circuit Break Signals.

By William K. Waldron.

In the practical operation of the third-rail electric power system it is often convenient and sometimes even necessary to divide the power circuit into sections, each section being fed from a separate substation or power house.

This division of circuit allows the cutting off of power from any given section in the event of any accident in that particular section, such as wrecks or fires, as well as for making repairs, while the balance of the line may be in full operation. Whenever the power is cut off from a section there is, of course, the danger of trains running from the adjacent "live" sections into this dead section, the results of which would be disastrous, causing the ruin of probably several motors and possibly injury to some of the workmen, if not the loss of human life.

To prevent such disasters each section break is provided with "break" signals, ordinarily known as "gap" signals, which warn the motorman of danger when he is approaching a dead section of circuit.

For the benefit of beginners desirous of acquiring a good, practical knowledge of electric railway equipment, the writer submits the following detailed description of the type of gap signal used on one of the largest elevated railway systems in this country.

These signals are controlled by two circuits, one from each adjacent third-rail section, neither of which is able to control the signals independently of the other; thus, when either section is "dead" both signals go to "danger."

The accompanying diagram is a plan of a signal layout, indicating the "section break," the ends of adjacent third-rail sections, signals and relay box, the latter containing the switches, fuses, resistance tubes and relay. The signals themselves are, of course, located one on the right-hand side of each track; the relay box may be located at any convenient point in the vicinage.

Designating the third-rail sections as *N* and *S*, as shown on sketch, the *S* section controls the relay. After tapping off from the third-rail the circuit passes through a 10-amp, 500-volt fuse. This fuse box is marked "relay," indicating that it is the relay fuse. The circuit then passes to and enters the relay box, where it passes through a snap switch and a 1-amp, 500-volt fuse, from which it enters a 4000-ohm resistance tube, 500 ohms of this resistance being cut out; as shown, 3500 ohms are effective. From this tube the current is led to the relay, which it picks up, thus completing the circuit for the signals. After passing through the relay the current is led to the ground.

The *N* section controls the signals. As in the relay circuit there is a 10-amp, 500-volt fuse, the box of which is marked "signal," indicating that this is the signal fuse. This circuit after passing through a snap switch contains a 3-amp, 500-volt fuse, and is led to the relay, after leaving which it is divided into two branches, one for each signal; both signal circuits being the same, one description will suffice. After the circuit is divided each branch passes through a 100-ohm resistance tube, thence to the bottom of a 1000-ohm tube, where it joins a lead to the signal passing through a solenoid coil to

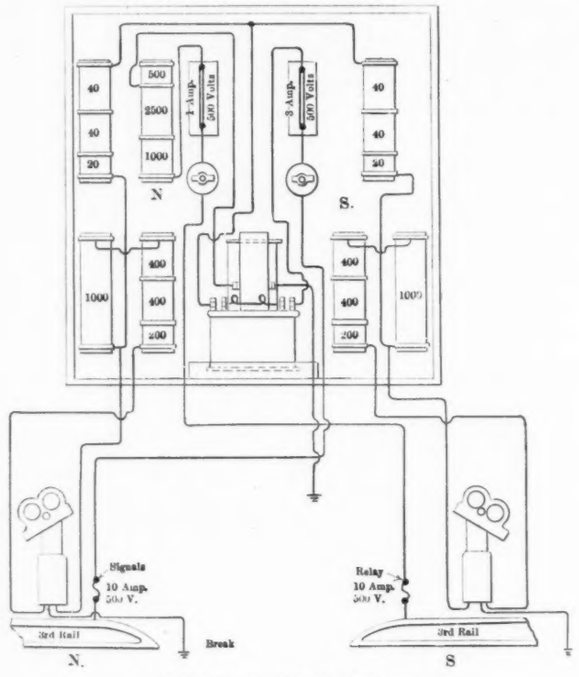


DIAGRAM OF SIGNAL CIRCUITS.

ground. This solenoid, in moving signal to "proceed" position, breaks the circuit, which then leads up through the 1000-ohm tube, across and down through another 1000-ohm tube, thence to signal as before, thereby holding the signal in "proceed" position.

Thus it will be seen that any defect in signal circuits after division of main circuit will put to "danger" the signal on the branch in which defect exists. A defect in the main circuit between the third-rail and the point of division will put both signals to "danger," as will also a defect in the relay circuit. Cutting off power in either section of the third-rail will, of course, put both signals to "danger."

These signals are provided with oil lamps, as to light by electricity would require connection with some other source of power, which is generally inconvenient.

The Construction of Ozonizers.

The production of ozone by electrical means is a development which has not received the attention in this country which the importance of the subject would seem to warrant. Comparatively few investigators are working along these lines and the degree of efficiency in the production of ozone is a matter of considerable interest. Ozone purification plants operated in conjunction with a city water-supply system are in common operation on the continent of Europe, but there is practically none in this country. With the single exception of what is

practically an experimental plant in conjunction with the water-works system in a small town in Canada, the ozone development in this particular field is undeveloped in this country. Their use, however, as a result of this development is undoubtedly apt to increase very greatly in the United States, and the use of ozone itself in a wide variety of operations, as a direct result of knowledge gained in regard to its production in this field both in the European installations and in the single one existing in this country.

Ozonizers for their operation need not be very large, and extremely high potentials are not necessary. The condition of the air before ozonization, as regards its temperature, pressure and hygrometric state, is a matter of considerable importance from an efficiency viewpoint in the operation of the ozonizers themselves, but is even of minor significance in practical developments where the preparation of the air in large quantities involves the installation of special units, such as refrigerating plants and drying devices and air compressors with heaters or coolers for its preparation.

The ozonizer in its commercial form consists of an iron box filled with a series of plates or electrodes, separated by plates of mica, somewhat like a condenser, and having the plates punched with a large number of small holes having rough edges, through which the air is drawn after passage over the plates of the electrodes. In commercial work current at a voltage of about 1040 volts is quite satisfactory, and this is carried into step-up transformers, where it is changed to give an e.m.f. of about 10,000 volts. The alternate plates in the ozonizers are connected to terminals of this voltage and the brush discharge occurs at the surface of the plates and from the irregularities in the innumerable small holes in its surface. The electrodes can be simply plates extending entirely across the iron box and insulated at the edges in each case, and may be practically air-tight as well. Alternate chambers will, therefore, be air reservoir chambers as well, and the air will enter in one chamber and be drawn out of the other, or may be required to pass through a series of such chambers and by a large number of electrodes. Its passage through each electrode is accomplished with considerable ozonizing effect on account of the close contact of the air with the brush discharge in the innumerable small holes.

The constructive details of such an ozonizer are not complete by any means, and are merely in the experimental stage. Cylindrical plates are undoubtedly capable of much more efficient installation and operation if the question of mica insulation and its production in efficient cylindrical units can be solved. Fiber has not been used to any great extent, but from the constructive standpoint the cylindrical type would undoubtedly prove its superiority with respect to air handling and minimum cost of construction if the insulation is not considered. It would then consist simply of a series of concentric metal pipes separated by the required insulation and having the air enter into the inner cylinder and leave from the exterior cylinder.

Undoubtedly the effects of preparation of the air have been over-estimated, at least from a commercial viewpoint, in the development of such ozonizers. The use of mechanical refrigeration for the drying of the air is common in most of the water purification plants in European countries, and air compressors are used as well for the transportation through the ozonizers. The fact that this air can be transported through the ozonizer by suction alone; that this suction can be obtained simply by the utilization of the aspirator principle common in many water developments, and that the immediate contact of the air with the water proves a suitable and adequate preparation of the water itself for such ozonizing effect, are points not generally understood. The effect of water in contact with the air, especially in conjunction with its commingling by means of aspirators, results in a complete purification of the air from all dust and ordinary impurities. Further, whatever air compression is gained is accomplished isothermally and the resulting compression diminishes the water content present in the air, strange as it may seem, although the water vapor present is, of course, in a saturated condition.

The construction and commercial development of ozonizers have been going on apace. Higher and higher voltages have been attempted and, as has been said, additional developments for the preparation of the air have been formerly considered indispensable. The fact of the matter is to-day that the commercial ozonizer in its development and utilization in a wide variety of applications is dependent more on constructive details and reliability of operation than upon any theoretical efficiency of the units in the production of ozone. Again, the position of the ozonizer in respect to its situation as an integral part of the plant, with its relation to other operating units, is of equal importance, and if these features received anywhere near the attention that the theoretical development has up to the present time, the commercial application of the electrostatic producing apparatus will increase remarkably in a comparatively short space of time.

CENTRAL STATION

MANAGEMENT, POLICIES AND COMMERCIAL METHODS

Readiness-to-Serve Rate Applied to Denver Residences.

The Doherty readiness-to-serve rate, which first came into prominence through its application to lighting in the business district at Denver, Col., is also proving adaptable to residence business as well. This rate as applied in the business district consists of a readiness-to-serve charge made up as follows: $1 per month for meter and service charge, plus 15 cents per month per 16-cp lamp connected. To the readiness-to-serve charge is added 5 cents per kw-hour for all electricity consumed as measured by meter.

In applying this rate to residences, it is manifestly unjust to apply the readiness-to-serve charge to all lamps connected as in the business district, because it is seldom that all the lamps in a house will be turned on at once. It is, therefore, the custom of the Denver Gas & Electric Company in figuring rates for a residence to make the readiness-to-serve charge of 15 cents per lamp on only half or a third of the connected load.

Out of the 22,000 residence consumers in Denver approximately 30 per cent are now on the readiness-to-serve rate. It is the company's custom to give consumers this rate whenever it will be to the consumer's advantage, rather than a straight 10-cent rate. The rate is mainly of advantage to consumers using considerable electricity in proportion to their connected load. For example, electric flatiron users can get a much lower rate by the readiness-to-serve plan than by the other plan. About one-third of the residences connected in Denver now have electric flatirons.

Electric Motors for Brick Plants.

In a paper recently read by Mr. E. A. Lof before the Iowa Brick and Tile Association, the advantages of electric power for operating brick and tile plants were presented, and the following data given as to the power requirements of machines in a brick plant with a yearly capacity of 25,000,000 brick:

Brick machine	75 hp
Pug mill	50 hp
Dry pans, each	35 hp
Represses and cutters	35 hp
Elevators	20 hp
Conveyors	8 hp
Exhaust fan	50 hp
Disk fan	10 hp

The aggregate for such a plant is thus about 250 hp. The fans would run 24 hours. Central stations having brick plants in their vicinity should find this class of prospective business worth looking into.

America's Dark Streets.

The New York *Evening Post* of Feb. 13 contains an interview with Dr. Louis Bell on the subject of street lighting, as follows:

"The principal streets in European cities, the streets, I should say, most in use after dark, are invariably better lighted than similar streets in America. This is so because, while in this country the average amount of energy per mile of street is from 5 kw to 10 kw, in Europe it is from 15 kw to 20 kw. Then, also, the price of carbons and the excellency of the product have much to do with the matter.

"In America we have what amounts to a carbon trust, which, at the time of the last revision of the tariff, succeeded in having the duty on carbon increased to $9 a thousand sticks. Immediately after this new ruling went into effect the trust raised its price on the domestic article by $9 a thousand sticks. But the American carbon trust has not attempted to improve its product. Its carbon is inferior to that in general use abroad.

"So it is impossible for the electric lighting companies to provide as adequate a service in New York as in Berlin, perhaps the best lighted city in the world. Still another reason why we have less effective light on our main thoroughfares is the desire, prompted by the greater cost of carbons, to make them last as long as possible. Consequently, our arc lamps are designed with an eye to economy of consumption, whereas, in Europe the fullest power is applied.

"Altogether, the price of American carbon is 100 per cent greater than that of European carbons, and it should be remembered in conjunction with this, that European carbons are longer-lived, so that they are doubly cheap. In European cities, too, there has recently been put into service a new type of carbon, loaded with various chemicals, primarily calcium fluoride, which have the effect of giving a more brilliant and yellower light than the ordinary carbon. Pearl globes as well, such as indeed we have on Fifth Avenue, are common all over the Continent and England. They do much to soften the brilliancy of the light, and diffuse it gradually, with a prettier effect on nearby shrubberies and buildings.

"This particular type of arc light is known as the flaming arc. Another improved type, not suited to main thoroughfares, but which is being adopted widely for side streets, is an incandescent lamp which has electrodes made of a somewhat rare metal called tungsten. These incandescents give fully twice as much light as do any others consuming the same amount of electricity. In my opinion they must eventually wholly displace gas on side streets and in the suburbs.

"Although two years or less ago they would have been more expensive than gas, a bid which came to me the other day offered to install tungsten incandescents at $18, as against $22 quoted for gas lamps. That seems to be a pretty fair indication of the development that has been accomplished in their manufacture.

"When it comes to the side streets of European towns, I don't think they are ahead of us. Conditions of lighting are practically the same. On the main streets I have already referred to, they place their lamps closer together than is our custom—at intervals of from 100 ft. to 130 ft., I should think, in contrast with the 200 ft. which generally separates lamps on American highways.

"Most European cities own their gas plants, but whether this is more profitable than private ownership, and, if so, just how much, it is very difficult to discover. Occasionally confusion is caused, as in the case of Paris, which owns gas plants, but has for many years taken its electricity from a number of small companies. Not long ago these companies banded together, and it is hoped that the result will be beneficial to the city's lighting service.

"Summed up, I believe that the chief things which we have to learn from European systems are more frequent distribution of lights, more energy in proportion to the extent of territory covered, and more artistic effects. The lamps might be hung higher above the sidewalk, and care might be taken to get a light that, while powerful, should be easy on the eyes, without the cruel whiteness of the plain arc light. Besides, much may be done in the way of designing graceful and ornamental poles to support the lights."

New Street-Lighting System at Aurora, Ill.

By C. J. McCarty.

Aurora, Ill., was one of the first cities in the United States to use the electric arc for street lighting. In 1881 seven 150-ft. towers were erected, on each of which were placed two lamps of the early open-arc type. About 10 years later all the towers but one were taken down on account of weakness and the lamps suspended on Brady arms along the street. A visitor in the city is reminded of the early system by lamps on the high tower of one of the east side schools. In the latter part of 1906 the municipal lighting plant was entirely rebuilt. About 400 Western Electric series enclosed-arc lamps replaced the old open-arc lamps and are operated 50 in series on a 4000-volt alternating-current circuit.

FIG. 1.—AURORA POST.

Recently 25 of these lamps in the business district were replaced by a system which has attracted considerable attention for the reason that it presents a very pleasing appearance to the eye and places light in abundance where it is most effective. The idea originated among the business men of the west side, who were looking over possibilities of booming the city. Many schemes were suggested. The plan of establishing a market place where cash would be paid for farm produce, and that of a 5-cent moving-picture vaudeville theater, where free tickets would be given by each merchant for a certain value in cash purchases, were considered. Finally, the scheme of brilliantly lighting the streets was chosen as being most likely to give quick results. The city had provided ample electricity for additional lighting, but had no money with which to purchase more lamps. Organization was perfected in the West Aurora Improvement Company, a charter obtained and a board of control appointed to plan and execute the work. A committee visited other cities and with the assistance of the city engineer and the city electrician, a plan of lighting was worked out which in some respects is similar to that in service at St. Louis. Proper ordinances were passed by the City Council whereby the merchants would install and pay for the system and then turn it over to the city for maintenance and operation. Similar movements were started in other parts of the business district which have resulted in a thorough lighting of the downtown streets.

The system consists of 173 ornamental, cast-iron posts, Fig. 1, carrying three lamps each, except at the four corners of each street intersection, where five lamps are placed on each post. The posts are spaced about 50 ft. apart along each side of the street on the curb line and have two arms, one extending toward the street and the other over the sidewalk. The arms curve downward and terminate in a 100-watt, 110-volt tungsten lamp, enclosed in a 10-in. opalescent globe. At the center of the post and extending upward is a 60-watt lamp enclosed in a 12-in. opalescent globe, this lamp serving more for decorative purposes. The tungsten lamps hang vertically. The weatherproof sockets are not rigidly attached to the framework, but hang loosely from the wires leading out of the arms. The

vibration from passing cars and heavily laden vehicles is thus less easily transmitted to the filament. The system is complete except for the Island, which will not be lighted until two concrete bridges spanning Fox River are completed.

Fig. 1 gives a good idea of the post. The lower part is 8¾ in. square, tapering to 7 in. square, 3 ft. above the base. From this point the post is fluted for 9 ft., at the top of which is a plate supporting the center lamp. The post stands 14 ft. high to the top of the globe and the side lamps are 4 ft. apart, the three globes forming a triangle. The posts were cast in a local foundry at a cost of $19.50, bids running as high as $66. Each post was painted one coat of bronze and one coat of best coach varnish at a cost of $1.40. A special curb was built outside the old curb and varied in width from 8 in. to 24 in. On this the posts are bolted. In this arrangement the sidewalk space was not diminished and it gave opportunity for concealing the conduit.

The conduit is a 2-in., second-hand, wrought-iron pipe purchased for 5 cents per foot. No. 0 stranded, double-rubber-covered, double-braided wire was drawn between junction boxes set in the curbing at each post, in each of which are placed a 5-amp or 8-amp enclosed fuse and a switch for cutting out the unit. The box is made water tight with a rubber gasket. No. 14 solid wire, double rubber covered and braided is used in reaching the lamps from the conduit box.

On the frontage basis the work was installed at a cost of $2.16 per front foot or at the rate of $103 per post. These figures cover the cost of the step-down transformers and all labor and material outside of extra power-house equipment and the line.

Energy is furnished from the city power station, located about two miles from the business district, and is carried on an existing pole line on two independent No. 6 circuits, one supplying the east side and one the west side. The city operates a combined pumping and lighting plant. The electrical equipment consists of a 300-kw Western Electric Company two-phase, 60-cycle, 2300-volt generator, direct-connected to a 450-hp, cross-compound, condensing Erie Ball engine which furnishes electricity for the street lighting system. All electricity in the city for private use is generated by a private company. The voltage from the generator is stepped up to 4000 volts through four Western Electric Company 100-light transformers for the arc lighting system, but is taken direct at 2300 volts to the center of distribution downtown and stepped down to 110 volts for the new lighting system; the lamps being wired in multiple.

From the standpoint of advertisement, the idea has succeeded

FIG. 2.—AURORA STREET BY DAY.

beyond expectation. Inquiries have been received from as great a distance as San Francisco and Seattle, while neighboring cities have had many delegations to see it. The illumination is very soft and of sufficient quantity to produce abundance of light and gives a good impression to all who see it. The local companies having poles in the streets willingly moved them into line and respaced them when necessary. By day the streets do not seem unnecessarily obstructed as might be supposed. The beauty of the posts and globes add to the appearance of the streets. It has been suggested by those in charge that the posts be spaced 75 ft. apart in the business district and 100 ft. apart in the residence district.

FIG. 3. AURORA STREET BY NIGHT.

A plan for series lamps with thicker filaments would be also practical. However, a part of this system has been operating since Nov. 21 last, and but one renewal has been made. In placing these lamps in position only one filament was found broken in the first test.

Wisconsin Classification of Electric Accounts.

The Railroad Commission of Wisconsin, acting under the public utilities law of that State, has promulgated a uniform classification of accounts for electric utilities. In an explanatory communication accompanying the classification the commission says that as circulars have been issued from time to time explaining the general principles upon which the accounts to be kept were to be based, and what subdivisions were to be made, a considerable number of utilities have for some time had in operation a system which conforms substantially to that submitted. The commission adds:

"The work in its present form is the result of an examination of accounting systems of practically all electric properties in this State supplemented by numerous conferences with electric company officials and their committee on accounting. It is desired that those electric utilities which have not already conformed their accounts to this system will do so at their earliest convenience. It is possible that after an adequate trial, some alterations will be found expedient both from the standpoint of general experience and practice or because of local and individual conditions. For the present, however, this classification is adherred to and prescribed and upon it will be based the annual report to be made to the Railroad Commission.

"Owing to the great difference in sizes of the properties it was found necessary to prepare two separate schedules which would recognize these conditions, and by each following the same general principles would permit comparison of operating results between the smallest and largest plants. Class B schedule is the basis upon which Class A schedule has been founded, the latter being an unfolding and refinement of the former.

"In general, electric utilities operating in cities of substantially 10,000 population or over will keep at least the list of accounts prescribed in Class A classification, and all electric utilities operating in cities under 10,000 population will keep at least the accounts prescribed in Class B classification. Upon this basis of division the opportunity for development will determine the accounts to be kept rather than the development which has actually been made. Here again, local and individual conditions must be recognized to do full justice and in a num-

ber of instances it is possible that this arrangement must be arbitrarily varied upon sufficient cause shown to the commission.

"Any utility in Class B desiring a more detailed classification than that prescribed for such class should open the accounts prescribed for Class A, and any utility in Class A desiring a more detailed system may go into as much subdivision and refinement of each of the submitted accounts as its interest requires, but must not re-arrange or combine any two or more of the accounts in such a manner as to interfere with the integrity of the general scheme and thus destroy the possibility for comparisons. A copy of all additional accounts and the desired subdivisions of the prescribed accounts must be filed with the Railroad Commission before such accounts are opened. All records and accounts, including those which are an enlargement, subdivision or refinement of the prescribed accounts, are to be open at all times to the examination of this commission.

"In order that this system may meet in a most satisfactory manner with the needs of the electric interests, consistent with the requirements of the public utilities law, it is urged that all companies which are unable for any reason to conform to the accounts for the class in which they naturally come under the above arrangements, will communicate with this commission, stating in full their reasons or conditions why special consideration should be given and an explanation of how complete a compliance with this system can be made."

The titles of the various accounts in the system are as follows:

INCOME ACCOUNT.

Class A and Class B.

Operating Revenues:
- Commercial lighting earnings.....
- Municipal contract lighting earnings.....
- Commercial power earnings.....
- Municipal power earnings.....
- Sales of electric current to other public utilities.....
- Miscellaneous earnings from operation.....

Total operating revenues.....

Operating Expenses:
- Power .....
- Transmission and transformation.....
- Storage .....
- Distribution .....
- Consumption .....
- Commercial .....
- General .....
- Undistributed .....

Total of above items.....
- Depreciation .....
- Contingencies (extraordinary).....
- Taxes .....

Total operating expenses.....

Net operating revenue or deficit.....
Non-operating revenues.....

Gross income or deficit.....

Deductions from gross income:
- Interest on funded debt.....
- Interest on real estate mortgages.....
- Interest on floating debt.....
- Contractural sinking fund requirements.....
- Amortization reserve requirements.....
- Miscellaneous deductions.....

Total .....

Net income or deficit.....

Disposition of net income:
- Preferred stock dividends.....
- Common stock dividends.....
- Appropriations to municipal funds (municipal plants only) .....
- Other payments from net income.....

Total .....

Surplus or deficit for year.....
Surplus or deficit at beginning of year.....
Adjustments during year (profit and loss account).....

Surplus or deficit at close of year (as per balance sheet)...

SCHEDULE OF REVENUE ACCOUNTS.

A. Operating Revenues.

Class A and Class B:
1. Commercial lighting earnings.
2. Municipal contract lighting earnings.
3. Commercial power earnings.
4. Municipal power earnings.
5. Sales of electric current to other public utilities.
6. Miscellaneous earnings from operation.

B. Non-Operating Revenues.

Class A and Class B:
1. Profit on merchandise sales (net).
2. Wiring and installation work (net).
3. Rents from land and buildings, conduits, pole lines and apparatus (net).
4. Interest on deposits.
5. Interest and dividends from investments.
6. Appropriations from municipal funds (for municipal plants only).
7. Miscellaneous non-operating revenues.

SCHEDULE OF OPERATING EXPENSE ACCOUNTS.

Class A and Class B.

Power:
- (A) Steam power generation.
- (B) Gas power generation.
- (C) Hydraulic power generation.
- (D) Electric current purchased (in lieu of electric current generated).
- (E) Steam generation (apportionment account).
- (F) Power gas production (apportionment account).
- II. Transmission and transformation.
- III. Storage.
- IV. Distribution.
- V. Consumption.
- VI. Commercial.
- VII. General.
- VIII. Undistributed.

I. POWER.

A. Steam Power Generation.

Class A.	*Class B.*
Operation:	*Operation.*
1a. Superintendence.	
1b. Engine labor.	1. Operating labor.
1c. Electrical labor.	
1d. Miscellaneous labor.	
2. Steam generation (accounts 20-25).	2. Steam generation (accounts 20-25).
3. Steam purchased.	3. Steam purchased.
4a. Lubricants.	
4b. Miscellaneous power plant supplies and expenses.	4. Miscellaneous power plant supplies and expenses.
Maintenance:	*Maintenance:*
5a. Maintenance of steam engines and turbines.	
5b. Maintenance of power plant auxiliary equipment.	
5c. Maintenance of generators.	5. Maintenance of power plant equipment.
5d. Maintenance of auxiliary power plant electrical equipment.	
6. Maintenance of power plant buildings, fixtures and grounds.	6. Maintenance of power plant buildings, fixtures and grounds.

B. Gas Power Generation.

Class A.	*Class B.*
Operation:	*Operation:*
7a. Superintendence.	
7b. Engine labor.	7. Operating labor.
7c. Electrical labor.	
7d. Miscellaneous labor.	
8. Power gas produced (accounts 26-31).	8. Power gas produced (accounts 26-31).
9. Power gas purchased.	9. Power gas purchased.
10a. Water for cooling engines.	
10b. Lubricants.	
10c. Miscellaneous power plant supplies and expenses.	10. Miscellaneous power plant supplies and expenses.
Maintenance:	*Maintenance:*
11a. Maintenance of gas engines and turbines.	
11b. Maintenance of power plant auxiliary equipment.	
11c. Maintenance of generators.	11. Maintenance of power plant equipment.
11d. Maintenance of auxiliary power plant electrical equipment.	
12. Maintenance of power plant buildings, fixtures and grounds.	12. Maintenance of power plant buildings, fixtures and grounds.

C. Hydraulic Power Generation.

Class A.

Operation:
- 13a. Superintendence.
- 13b. Hydraulic labor.
- 13c. Electrical labor.
- 13d. Miscellaneous labor.
- 14. Hydraulic power purchased.
- 15a. Lubricants.
- 15b. Miscellaneous power plant supplies and expenses.

Maintenance:
- 16a. Maintenance of dams, canals and flumes.
- 16b. Maintenance of turbines and water-wheels.
- 17a. Maintenance of power plant auxiliary equipment.
- 17b. Maintenance of generators.
- 17c. Maintenance of auxiliary power plant electrical equipment.
- 18. Maintenance of power plant buildings, fixtures and grounds.

Class B.

Operation:
- 13. Operating labor.
- 14. Hydraulic power purchased.
- 15. Miscellaneous power plant supplies and expenses.

Maintenance:
- 16. Maintenance of hydraulic power works.
- 17. Maintenance of power plant equipment.
- 18. Maintenance of power plant buildings, fixtures and grounds.

D. Electric Current Purchased.

(In lieu of electric current generated.)

Class A and Class B.

- 19. Commercial electric current purchased.

E. Steam Generation.

(Apportionment account.)

Class A.

Operation:
- 20. Operating labor.
- 21. Fuel for steam.
- 22. Water for steam.
- 23. Miscellaneous steam supplies and expenses.

Maintenance:
- 24a. Maintenance of boilers and boiler auxiliary equipment.
- 24b. Maintenance of coal and ash-handling equipment.
- 25. Maintenance of boiler plant buildings, fixtures and grounds.

Class B.

Operation:
- 20. Operating labor.
- 21. Fuel for steam.
- 22. Water for steam.
- 23. Miscellaneous steam supplies and expenses.

Maintenance:
- 24. Maintenance of boiler plant equipment.
- 25. Maintenance of boiler plant buildings, fixtures and grounds.

F. Power Gas Production.

(Apportionment account.)

Class A.

Operation:
- 26. Gas producer operating labor.
- 27. Gas producer fuel.
- 28. Gas producer water.
- 29. Miscellaneous gas producer supplies and expenses.

Maintenance:
- 30a. Maintenance of gas producers and gas producer equipment.
- 30b. Maintenance of coal and ash-handling equipment.
- 31. Maintenance of gas producer buildings, fixtures and grounds.

Class B.

Operation:
- 26. Gas producer operating labor.
- 27. Gas producer fuel.
- 28. Gas producer water
- 29. Miscellaneous gas producer supplies and expenses.

Maintenance:
- 30. Maintenance of gas producer equipment.
- 31. Maintenance of gas producer buildings, fixtures and grounds.

II. TRANSMISSION AND TRANSFORMATION.

Class A and Class B.

Operation:
- 32. Inspecting and patroling transmission system.
- 33. Substation and transformer station operating labor.
- 34. Substation and transformer station supplies and expenses.

Maintenance:
- 35. Maintenance of transmission system.
- 36. Maintenance of substation and transformer station equipment.
- 37. Maintenance of substation and transformer station buildings, fixtures and grounds.

III. STORAGE.

Class A and Class B.

Operation:
- 38. Storage battery operating labor.
- 39. Storage battery supplies and expenses.

Maintenance:
- 40. Maintenance of storage battery equipment.
- 41. Maintenance of storage battery buildings, fixtures and grounds.

IV. DISTRIBUTION.

Class A.

Operation:
- 42a. Labor, removing and resetting meters.
- 42b. Labor, inspecting, removing and resetting transformers.
- 42c. Labor, inspecting and testing meters.
- 42d. Miscellaneous distribution system operating labor.
- 43a. Meter department supplies and expenses.
- 43b. Miscellaneous distribution system supplies and expenses.

Maintenance:
- 44a. Maintenance of overhead distribution system.
- 44b. Maintenance of underground distribution system.
- 45. Maintenance of transformers.
- 46. Maintenance of meters.

Class B.

Operation:
- 42. Distribution system operating labor.
- 43. Distribution system supplies and expenses.

Maintenance:
- 44. Maintenance of distribution system.
- 45. Maintenance of transformers.
- 46. Maintenance of meters.

V. CONSUMPTION.

Class A and Class B.

Operation:
- 47. Trimming and inspecting lamps.
- 48. Lamp supplies.
- 49. Incandescent lamp renewals.
- 50. Miscellaneous consumption supplies and expenses.
- 51. Customers' premises expenses.

Maintenance:
- 52. Maintenance of lamps.

Note: While the above represent the ledger accounts to be kept by all electric plants, the following items will be called for in the report to the Railroad Commission, the apportionment being made upon the lamp hours basis.

Commercial.

- 47a. Trimming and inspecting commercial lamps.
- 48a. Commercial lamp supplies.
- 49a. Commercial incandescent lamp renewals.
- 50a. Miscellaneous commercial consumption supplies and expenses.
- 51. Customers' premises expenses.
- 52a. Maintenance of commercial lamps.

Municipal Contract Lighting.

47b. Trimming and inspecting municipal contract lamps.
48b. Municipal contract lamp supplies.
49b. Municipal contract incandescent lamp renewals.
50b. Miscellaneous municipal contract lighting supplies and expenses.
52b. Maintenance of municipal contract lamps.

VI. COMMERCIAL.

Class A.

53a. Collection salaries and commissions.
53b. Reading meters and delivering bills.
53c. Collection supplies and expenses.
53d. Uncollectable accounts (reserve charge).
54a. Promotion of business salaries and commissions.
54b. Promotion of business supplies and expenses.

Class B.

53. Collection expenses.

54. Promotion of business expenses.

VII. GENERAL.

Class A.

Operation:
55a. Salaries of general officers.
55b. Salaries of general office clerks.
56a. General office rent.
56b. Miscellaneous general office supplies and expenses.
57. Law expenses—general.
58. Miscellaneous general expenses.
59. Railroad Commission expenses.

Maintenance:
60. Maintenance of general office equipment.
61. Maintenance of general office buildings, fixtures and grounds.

Class B.

Operation:
55. General office salaries.
56. General office supplies and expenses.
57. Law expenses—general.
58. Miscellaneous general expenses.
59. Railroad Commission expenses.

Maintenance:
60. Maintenance of general office equipment.
61. Maintenance of general office buildings, fixtures and grounds.

VIII. UNDISTRIBUTED.

Class A and Class B.

62. Injuries and damages.
63. Insurance.
64. Stationery and printing.
65. Operation of stores department.
66. Maintenance of stores department equipment.
67. Maintenance of stores department buildings, fixtures and grounds.
68. Operation of utility equipment.
69. Maintenance of utility equipment.
70. Maintenance of utility equipment buildings, fixtures and grounds.

DEPRECIATION.

Class A and Class B.

Depreciation reserve charge.

CONTINGENCIES (EXTRAORDINARY).

Class A and Class B.

Contingencies (extraordinary) reserve charge.

TAXES.

Class A and Class B.

Taxes.

DEDUCTIONS FROM GROSS INCOME.

Contractual Accounts.

Class A and Class B.

1. Interest on funded debt.
2. Interest on real estate mortgages.
3. Interest on floating debt.
4. Contractual sinking fund requirements.

RESERVE ACCOUNTS.

Required Permanent Reserves.

Class A and Class B.

1. Depreciation reserve.
2. Sinking fund reserve.
3. Amortization reserve.

OPTIONAL RESERVES.

Class A and Class B.

1. Maintenance reserve.
2. Uncollectible accounts reserve.
3. Promotion of business reserve.
4. Injuries and damages reserve.
5. Insurance reserve.

SCHEDULE OF STOCK ACCOUNTS.

Class A and Class B.

1. Fuel.
2. Power plant supplies.
3. Electric line material.
4. Transformers.
5. Meters.
6. Lamps and lamp supplies.
7. Electric appliances.
8. Miscellaneous stock.

SCHEDULE OF CONSTRUCTION AND EQUIPMENT ACCOUNTS.

Class A and Class B.

Intangible:
1. Organization.
2. Franchises.
3. Rights, licenses, etc.

Tangible:
4. Land (used in operation of property):
   a. Power plant land.
   b. Substation and transformer station land.
   c. Storage battery land.
   d. General office land.
   e. Stores department land.
   f. Utility equipment land.
5. Buildings, fixtures and grounds (used in operation of property):
   a. Steam power plant buildings, fixtures and grounds.
   b. Gas power plant buildings, fixtures and grounds.
   c. Hydraulic power plant buildings, fixtures and grounds.
   d. Boiler plant buildings, fixtures and grounds.
   e. Gas producer plant buildings, fixtures and grounds.
   f. Substation and transformer station buildings, fixtures and grounds.
   g. Storage battery buildings, fixtures and grounds.
   h. General office buildings, fixtures and grounds.
   i. Stores, department buildings, fixtures and grounds.
   j. Utility equipment buildings, fixtures and grounds.
6. Power plant equipment:
   a. Steam power plant equipment.
   b. Gas power plant equipment.
   c. Hydraulic power works equipment.
   d. Hydraulic power plant equipment.
   e. Boiler plant equipment.
   f. Gas producer equipment.
7. Transmission and transformation:
   a. Transmission system.
   b. Substation and transformer station equipment.
8. Storage battery equipment.
9. Distribution:
   a. Distribution system.
   b. Transformers.
   c. Meters.
10. Commercial lamps and lamp equipment.
11. Municipal contract lighting system.
12. General office equipment.
13. Stores department equipment.
14. Utility equipment.
15. Miscellaneous equipment.
16. Miscellaneous construction and equipment expenditures:
   a. Salaries.
   b. Office supplies and expenses.
   c. Stationery and printing.
   d. Law expenses.
   e. Injuries and damages.
   f. Insurance.
   g. Interest.
   h. Taxes.
   i. Discount on bonds.
   j. Miscellaneous.
17. Cost of plant purchased (in lieu of plant constructed).

BALANCE SHEET.

Assets.

Class A and Class B.

Property and Plant:
Cost beginning of year.
Construction and equipment current fiscal year.
Cost close of year.
Treasury Securities:
Treasury stock.
Treasury bonds.
Investments:
Stocks and bonds of other companies.
Other investments.
Reserve, Sinking and Special Fund Assets:
Depreciation reserve fund.
Sinking fund.
Amortization reserve fund.
Special funds.
Current Assets:
Cash.
Notes and bills receivable.
Accounts receivable.
Interest and dividends receivable.
Material and supplies.
Sundry current assets.
Prepaid Accounts:
Prepaid insurance.
Prepaid taxes.
Prepaid interest.
Sundry prepaid accounts.
Open accounts.
Deficit.

BALANCE SHEET.

Liabilities.

Class A and Class B.

Capital Liabilities:
Capital stock, preferred.
Capital stock, common.
Funded debt.
Mortgage Liabilities:
Real estate mortgages.
Other mortgages.
Current Liabilities:
Notes and bills payable.
Accounts payable.
Matured interest on funded debt unpaid.
Matured interest on notes and bills payable unpaid.

Dividends unpaid.
Deposits.
Sundry current liabilities.
Accrued Liabilities:
Insurance accrued.
Taxes accrued.
Unmatured interest on funded debt accrued.
Unmatured interest on notes and bills payable accrued.
Dividends accrued.
Sundry liabilities accrued.
Open accounts.
Reserve, Sinking and Special Fund Liabilities:
Depreciation reserve.
Sinking fund.
Amortization reserve.
Special funds.
Surplus.

The classification was discussed at the recent meeting of the Wisconsin Electrical Association, at Milwaukee, by Mr. C. N. Duffy, comptroller of the Milwaukee Electric Railway & Light Company.

Mr. Duffy said that the association had appointed a committee a year ago to work in connection with a committee appointed by the Wisconsin Railway & Interurban Association. These committees were to confer with the commission regarding the subject of uniform classifications of accounts for the electric lighting properties and the electric railways. Mr. Duffy was the chairman of the committee of the Northwestern Electrical Association. The classification of accounts for electric lighting properties was considered by Mr. Duffy, speaking from a disinterested standpoint, as serving all the purposes of the commission. He did not understand how anybody engaged in the electric lighting business would be willing to conduct it and to know less than would be required by this classification.

Mr. Duffy spoke of the meetings with Mr. W. P. Hagenah, statistician of the committee, and the conferences with representatives of the railway association and members of the committees. He said that Mr. Hagenah had made a thorough and analytical investigation of the question of accounts. In the course of his study Mr. Hagenah visited different parts of the country and various plants and had conferences in New York with representatives of the American Gas Institute, the National Electric Light Association and the Public Service Commission of New York, First and Second districts. The classification of accounts which was finally prepared was intended primarily for the uses of the commission, which unquestionably had a right to ask for what it thought might be required. Upon the information furnished under the system of accounts, the commission must base its decisions as to the fairness of rates. Mr. Duffy thought that the electric lighting companies of Wisconsin should be willing in their own interest to co-operate with the commission in this matter. The fundamental principle laid down in the classification of accounts, Mr. Duffy said, is that the method of generating electric current, whether by steam power, gas producer power or hydraulic power, should be kept separate and distinct from the other expenses.

It was then stated by Mr. Duffy that the United Railways Company, of St. Louis; the Union Electric Light & Power Company, of St. Louis, and the Milwaukee Electric Railway & Light Company, all of which are controlled by the North American Company, had been endeavoring for three or four years to work out a uniform classification of power accounts for comparison for their own purposes. When the Wisconsin classification was issued the representatives of these companies realized that it was nearer what they had been trying to get than anything else they had seen. The engineers of the Milwaukee company and of various other companies had given assistance and criticism to Mr. Hagenah and Mr. Duffy, representing the committee, in the preparation of the accounts. As the officials of the St. Louis companies were impressed with the classification two conferences were held in St. Louis, with the result that the two companies in that city decided to adopt the classification of power accounts as of Jan. 1, 1909. The results of operation of the power plants of the St. Louis companies, the Milwaukee company and also of companies in Kenosha, Watertown, Racine and Appleton, Wis., which are controlled by the same interests, will be shown, therefore, on blanks that will be identical and will be interchanged between the various companies.

Mr. Duffy also discussed briefly the details of the classification. He thought it would be possible for any company to report its earnings in accordance with the form of the income account. His experience had been that a great many of the smaller companies reported their earnings in greater detail than was required by the classification of the commission. Mr. Duffy, however, called attention to the suggestion of the commission that companies which are unable to conform to the requirements communicate that fact to the commission, stating reasons why special consideration should be given to needs in individual instances. While no classification could be a classification of accounts, a reflector of specific conditions at each plant, an analytical cost system, and a statistical data exhibit, a classification should perform these functions in a broad and general way; and Mr. Duffy said that the Wisconsin classification accomplished that purpose.

INTERIOR WIRING AND ILLUMINATION

Central-Station Illuminating Engineering at Denver.

The Denver (Col.) Gas & Electric Company now has Mr. C. F. Oehlman, one of its new-business force, giving his entire time to illuminating engineering work, endeavoring to straighten out the installations of dissatisfied customers so as to convert them into satisfied customers and working upon those who are now using gasoline. The tungsten lamp is being introduced to give more light for the same money, this being the first active effort made by this company in pushing illuminants of higher efficiency than the common carbon-filament lamp and the enclosed alternating-current arc lamp.

Electric Sign Advertising.

The electric sign for advertising purposes is being used effectively by the Western Electric Company at its manufacturing plant in Hawthorne, Ill., and at its building in New York City. In the latter city this company has placed on the top of its 13-story structure, which faces on the North River, an electric sign over 200 ft. long, with letters 9 ft. high, made up of 1000 2-cp lamps. This sign is conspicuous even from the New Jersey shore. It is viewed by thousands of persons daily, Jersey commuters, passengers on Atlantic lines, coastwise steamers and others.

At Hawthorne this company's electric sign faces the main line of the Chicago, Burlington & Quincy Railroad out of Chicago. Over this line upward of 90,000 persons travel weekly. Of these about 75,000 are suburban passengers, while about 15,000 are through passengers. Fifty per cent of the travel is between the hours of 5 p. m. and midnight. The sign being so conspicuous on account of its size, brilliancy, etc., it is safe to say practically all of these people have become acquainted with it. Of course, the results that these signs bring are not felt directly, but they are making the name of the concern familiar to hundreds of thousands of people, and the indirect results, it is believed, greatly outweigh the expense made in erecting and maintaining these signs.

A Contractor's Canvass for Residence Lighting.

Mention was made in these columns last summer of the progressive policy of the Sanborn-Marsh Electric Company, of Indianapolis, Ind., which has been canvassing the residence districts of Indianapolis for securing house-wiring business. This canvass was conducted by women solicitors, who carried with them electric irons for sale. In houses which were already

wired the attempt would be made to leave these irons on two weeks' trial. By this means the solicitors would find out which houses had electric service, which houses were wired and not connected and which were unwired. The solicitors visited every house and were required to make as complete reports as possible on the condition of the house as regards wiring and the attitude of the owner toward having the house wired. The solicitors were paid $6 per week plus a commission on the irons which they sold.

When the canvass was over the company had a complete card index record on all the houses, and in many cases the information as to the sentiment of the owner regarding wiring was exhaustive. The best prospects were sorted out and advertising literature mailed to them occasionally. The profit on the flatiron sales paid for the canvass. The Simplex iron was supplied, the lowest-priced household iron being $4.50. The circulars now being sent out are both on electrical appliances and on the advantages of having a house wired. The company is employing no solicitors, but estimators follow up all inquiries which come in reply to these circulars. It is found that this method of handling the business gets results at an expense which is not prohibitive for the contractor.

This company is endeavoring in every way to cultivate the idea that its wiremen are neat and careful, and that the wiring of an old house does not necessarily mean leaving it in a very dirty and battered-up condition, as many suppose.

Special Street Lighting at Parkersburg.

A good example of the arch arrangement of incandescent lamps for street illumination is found at Parkersburg, W. Va. Along one of the main business thoroughfares of the city there have been placed iron lattice-work arches spanning the street from curb to curb at a sufficient height not to interfere with the

ARCH LIGHTING AT PARKERSBURG.

double line of trolley cars. These arches are equipped with incondescent lamps that are used for decorative illumination over the street on each Saturday night. The accompanying illustration shows the use made of one of these arches at the time of the U. C. T. convention in Parkersburg.

Importance of Illuminating Engineering.

By Alfred A. Wohlauer.

The satirical article entitled "Illuminating Engineering vs. Common Sense," by Basil G. Kodjbanoff, printed in the issue of Jan. 21, may influence unfavorably the standing of the illuminating engineer, and the writer therefore considers it a duty to take issue with some of the statements which it contains. Although agreeing with a number of statements, especially as to the incompetence of some of those who pose as illuminating engineers, and as to the undeveloped state of the science of illuminating engineering, still the title alone of the article would reflect on illuminating engineers in general if it were not compensated by the following concession by the author: "I do not wish to be understood as maintaining there is not sufficient material and field of operation for a science and art of illumination. Not only is the subject as a whole sufficiently comprehensive to afford ample opportunities for the specialist, but it is capable of being subdivided into departments, each of which is sufficiently large to constitute a specialty." A science and art of which the above may be said can by no means be void of common sense. While thus the author counteracts the effect of the title of his article, other statements remain with which to be contended.

He says: "When all the figuring (of the illuminating engineer) has been done, are the results any better than would have been obtained by any good electrical engineer or architect who has had experience coupled with observational power?" To this the reply can be made: "Yes, many times better. Ninety-nine out of a hundred buildings erected at the present time are not satisfactory from the viewpoint of correct illuminating engineering. It is true that in numerous cases considerable deliberation and even experience are required on the side of a good and conscientious illuminating engineer who wants to do a better job than the experienced contractor or architect. But if he arrives at some definite results his work will unquestionably excel many times that of the latter. It is not only the use of up-to-date illuminants, tungsten lamps, mercury-vapor and flaming-arc lamps which make his work superior, but also his ability to apply consistently results derived from theoretical and practical study which enables him to arrive at his figures. It must be admitted that the results at the present time are not always perfect and will be better in the future, but astonishingly much has been accomplished so far which, if properly followed up, must put the work of the illuminating engineer high above that done by a layman.

Another remark tends to put the work of the illuminating engineer down to the level of goods offered at a bargain sale. An illumination well laid out is efficient, economical, efficacious, practical, artistic, hygienic, etc., and therefore less expensive than an illumination which is void of these characteristics, but it cannot be classified with cheap goods. In fact, it may involve a higher initial expense if the work and time devoted to it by the illuminating engineer are considered, but it will pay in the end.

The author claims that mathematical calculations of illumination are of no avail and just as ridiculous as "the theoretical designing of a corkscrew built on engineering principles." This is entirely incorrect; in fact, a corkscrew actually and properly built on engineering principles would represent an accomplishment worth while considering and buying if it were cheap enough.

While the author professes to consider that there is a large field of operation for the science and art of illumination, in his good intention to purge the new profession of the unscrupulous and therefore undesirable elements, he nearly comes to doing more harm than good. Much can be achieved in improving illumination, often by an application of very simple schemes and rules; and although the author is correct that "the knowledge and skill requisite to constitute an engineering profession is not something to be put on like a garment," it is more important to improve illumination than to prevent people from professing to be illuminating engineers.

New Telephone Patents.

IMPROVED RECEIVER.

It has been usual for a long time to support the thin metallic diaphragm of a telephone receiver directly upon the casing or magnet mounting, relying for spacing upon the relation of the planes of the pole faces and that of the diaphragm support to provide the proper air-gap between the diaphragm and the pole-pieces. With this arrangement it has also been customary to clamp the diaphragm against its support by means of the ear-cap piece. It has been found that as this cap is screwed home its friction upon the diaphragm may at times cause initial buckling or other strains.

Mr. A. Stromberg, of Chicago, has employed a different ar-

rangement in a receiver recently patented by him. He has surrounded the edge of his diaphragm with a rather substantial ring-piece, which is spun over both faces to the amount of a small fraction of an inch. When the ear-cap is screwed to place its twisting pressure comes directly upon the ring binding and the diaphragm itself is in this way relieved of any undue strains.

Moreover, the ring lifts the diaphragm more than normal from the supporting face and this action is used to advantage by having the flange of gage thickness equal to the desired spacing between the diaphragm and the pole-face, and the diaphragm-supporting face is so arranged that it lies exactly in the plane of the magnet pole-faces. It will thus be seen that each diaphragm carries its own adjusting spacer incident to the strengthening ring.

CLEARING-OUT DROP-CONTROL CIRCUIT.

With those switchboard circuits in which a clearing-out drop bridged across a cord-pair is used to indicate the termination of a conversation it has been found that, when condensers are included in the subscriber station circuits, if by chance upon calling a station the ringing key of the cord circuit is released at the top of a wave of current the back-kick from the condenser will throw the clearing-out drop. This action happens particularly often where there are many stations connected to the line being rung, the condensers at various stations acting cumulatively to make a considerable back discharge, even with a low impressed voltage.

Mr. C. A. Simpson, of Chicago, has designed drop-control circuits to overcome this annoyance, having provided the ringing keys with auxiliary contacts so arranged that whenever the ringing key is thrown an auxiliary relay is cut into circuit, its contact closing a low-resistance path across the cord-pair between the clearing-out drop and the innermost contacts of the nearest ringing key. As soon as any one of the keys is depressed in ringing, the auxiliary relay responds, thereby short-circuiting the clearing-out drop; when the ringing key is released the condenser discharge, occurring practically simultaneously therewith, takes place across the relay path instead of through the clearing-out drop, before the relay has had time to fall back.

AUDIPHONE TRANSMITTER.

As is well known, audiphone transmitting instruments are usually carried suspended about the person of the user and it most frequently happens that the clothing of the user is immediately in contact with the audiphone transmitter, the result being that the yielding substance of the clothing acts as a damper for the transmitter. Mr. C. E. Williams, of Natick, Mass., has obtained a patent for an audiphone transmitter designed to overcome this difficulty. It will, of course, be understood that such transmitters are designed to pick up the maximum of extraneous sounds; in order to increase the efficacy he has associated the transmitter with a sounding-board casing of hard rubber. The sounding board has sides like an open box and it lies against the person of the user. The front of the sounding board, to which the transmitter is directly secured, is slightly smaller than the rear part, so that sound impinging upon the instrument is effective in two ways. The sound that impinges on the front cover acts directly on the transmitter, while that which impinges on the open space between the front cover and the edges of the sides of the box strikes against the bottom of the rear and is there reflected to the transmitter.

PARTY-LINE RINGING DEVICE.

A step-by-step switching device for controlling lock-out party-line stations is the subject of a patent granted to W. Hagstrom, of Lindsborg, Kan. This is a polarized electromagnetic device which responds to impulses in one direction to drive forward a step device, thereby connecting one station after the other to the line, the desired station corresponding to the total number of impulses sent. Upon reverse currents being applied after conversation is complete, the releasing pawls are withdrawn to permit the return to zero at all the stations.

LETTERS TO THE EDITORS.

Wireless Telegraph Inductance Coils.

To the Editors of Electrical World:

SIRS:—Referring to the article by Mr. John L. Hogan, Jr., on "Inductance Coils Used in Wireless Telegraphy," in your issue for Feb. 18, we wish to state that our "variometer" type of inductance or tuning coil, based on the principle of the Ayrton and Perry standard, has formed a part of our regular receiving sets since 1905. These coils are also provided with a simple switch for cutting them entirely out of circuit when even the minimum inductance obtainable with the two coils in complete opposition is too high.

We have always advocated and used loose coupling, both sending and receiving, and with one movable coil—for varying the coupling—and with both the movable and the stationary coil variable. We employ this type particularly in connection with our receivers, but have also supplied transmitters with two independent variable coils inductively coupled and with one of the coils movable for varying the coupling.

TELEFUNKEN WIRELESS TELEGRAPH CO. OF NEW YORK.

To the Editors of Electrical World:

SIRS:—In reading the editorial "Inductance Coils Used in Wireless Telegraphy," in the issue of Feb. 18, 1909, one is struck by the statement that in fixed coils with variable points of contact the inductance varies nearly as the square of the number of included turns. The approximate expression for the inductance of a helical conductor is

$$L = (\pi dn)^2 l$$

where L represents the total inductance, d the diameter of helix, n the *number of turns per unit length* and l the length of the coil. Assuming n to be constant (as is usual), the total number of turns will be proportional to the length l. In all ordinary construction d is constant, whence it is certain that the amount of inductance in the circuit varies directly with the mechanical displacement of an axially sliding contact.

NEW HAVEN, CONN. JOHN L. HOGAN, JR.

Valuation of Public Utility Properties.

To the Editors of Electrical World:

SIRS:—I note in your article on the Supreme Court decision in the Knoxville water case (issue of Feb. 11) what appears to me a fallacy in the reasoning of the Supreme Court on the subject of depreciation. The court says:

"If, however, a company fails to perform this plain duty, and to exact sufficient returns to keep the investment unimpaired, whether this is the result of unwarranted dividends upon over-issues of securities or of omission to exact prices for the output, the fault is its own. The court could not undertake to correct such past errors of management."

Unless I misapprehend the application of this it means that returns can only be computed on the existing structural value of the plant—that is, the cost of reproduction diminished by an allowance for decreased value due to age. Or, put in another way, that the wages of a servant should be diminished as his age increases, unless he has been able to lay aside adequate provision for old age, even though age has not diminished the quality or amount of the work he performs; or, again, that of two servants performing identical duties, the younger should receive the higher pay, unless the older has accumulated property.

The fallacy consists in failing to perceive that, while purchase value is affected by age, rental value (in the absence of decreased efficiency) is not. To further illustrate: Assume that two horses are for sale, both of whom can do the same day's work, and that one of them is much older than the other. It is clear that the younger horse will bring the higher price, as the additional length of time during which he will be useful is a

vital factor. Assume, again, that these two horses are offered for hire; is there anyone who will dispute that, as long as they do equivalent work, they are entitled to the same earnings?

I believe that failure to recognize the difference between sale and rental values, in public utility cases, has been due to the false assumption that the purchaser at depreciated prices would need to consider only such prices in fixing rates of return, and that, therefore, there was no justice in allowing the owners to charge rates based on larger sums. This assumption fails to take into account the fact that the sum which must be accumulated for rebuilding is not the depreciated cost paid, but the original cost; and that, therefore, to escape loss, such a purchaser must do either one of two things: First, at once place in a depreciation fund the difference between the price paid and the cost of reproduction, new; or, second, collect each year, in addition to the current depreciation, a further sum which will make up the past depreciation during the remaining life of the plant. In either case, in order to obtain the same net earnings, the rates charged must be equal to those charged on a new plant.

It appears to me to be of immense importance to the public utilities of the country that the fact of rate of return being a function of reproductive—and not of depreciated—value, be firmly established.

Superior, Wis. W. H. Winslow.

The Metric System.

To the Editors of Electrical World:

Sirs:—The recent important action taken by the American Society of Civil Engineers, in favor of metric reform, has been received with much satisfaction by all in Europe who know the advantages that metric reform has there brought about, and who are desirous both of extending these advantages to other countries and of seeing the whole world adopt a uniform language in all departments accessible to measurement, for facilitating international transactions which are becoming constantly more frequent.

The great importance of the discussion announced for Jan. 20 requires that it should be elucidated as fully as possible, and that every trace of misunderstanding should be eliminated therefrom in advance. A perusal of the article published in your number of Nov. 9 has made me fear that some little hesitation still exists in the interpretation of the law of the United States relative to systems of measurement, and it is on this account that I beg to take part in the discussion of the subject.

Let us first establish a principle that experience has many times confirmed in the past. A mere *authorization* to employ a simple and rational system of measurements in commercial transactions, as a substitute for a much less perfect system long established by usage, is not sufficient to bring about a reform. In fact, in commercial affairs, the buyers and sellers are dependent one upon the other in such a manner that unless one of them completely dominates the situation, neither is able to take the initiative toward the adoption of the improved measurements. The authorization of the employment of improved measures rests, therefore, a dead letter for all the internal commerce of a country, and only the external commerce is in a position to benefit thereby. In order to bring about, not the entire application, but even a partial application, of the improved system in the purchase and sale of commodities, it is necessary to make the new measures *obligatory*.

The situation is quite different in manufacturing. Here each individual possesses a much greater degree of liberty. Each manufacturer can introduce into his factory the new system without reference to the action of neighboring factories, and only with reference to his own better advantage.

Nevertheless, it must be admitted that the introduction of metric reform into the shop of an individual manufacturer is apt to present a considerable difficulty, such as is likely to retard the enterprise for a considerable period. Here again uniformity of action, without being indispensable as in commerce, at least offers marked advantages, and it may be said that the adoption of a rational system of weights and measures, as a substitute for a less perfect system, is advantageous in proportion as the system is generally recognized and employed.

But the industrial situation is distinguished from the commercial situation by two important factors. Firstly, the number of individuals interested in the industrial reform is much more limited, and they possess a technical education considerably above the public average. Secondly, those interested in industry are more apt to recognize and adopt an innovation, and, moreover, they reach a mutual understanding with far less difficulty, an advantage which gives an impetus to reform, at least among those engaged in the same branch of industry.

The sole condition necessary for bringing about such a result is that the system of measures to be introduced shall be *authorized* by law.

In this connection the situation of the metric system in the United States is especially advantageous. The metric system is the only system which has been legalized in the entire Union. The customary measures, on the other hand, are well known to be more or less variable, having been recognized only by the laws of individual States. No general law has ever been imposed by the United States for the employment of the yard, the pound, the gallon or the bushel. Whereas, by the act of July 23, 1866, the metric system was declared legal from the Atlantic to the Pacific.[1]

Nothing would prevent, then, the manufacturing establishments of the United States from adopting the metric measures. In order that this adoption should be immediately advantageous to any, I think it would be sufficient that a considerable number among them should come to an understanding to effect the reform simultaneously, so as to constitute a co-operative union of interests, toward which the outsiders would be gradually drawn into conformity.

The possibility of such an understanding has been clearly demonstrated at various times by the experience of European manufacturers. In Switzerland, for example, where the metric system is obligatory in commerce, but where all kinds of measurements are authorized within factories, a long-established custom caused watchmakers to adhere to their old measurements, based on the Paris foot. In consequence, however, of an agreement between the large factories, and an actively prosecuted campaign, the old system of measurements, which was in very general use five years ago, has almost entirely disappeared from the watchmaking industry, which will certainly be completely freed from the last vestiges of the old system in the course of the next five years.

Another example of an understanding, international in this case, has been given by the extension of the system of metric screw-threads, which all the recent industries of continental Europe have adopted, and which the long-established manufacturies are adopting as time goes on and as the originally existing plant becomes worn out. At the present day the international metric system of threads, officially sanctioned less than 10 years ago, is certainly the most extensively used system in the mechanical industries of continental Europe.

Metric reform would be greatly facilitated in the United States by certain fortunate conditions there existing, in reference to particular groups of manufacturers, the most interested in the use of a simple and rational system of measurements, reducing computations to a minimum.

Thus the law gives to American engineers every opportunity for the adoption of metric measurements. The introduction of factory measurements is at the same time placed within their control in a very effective manner. There are certain American firms (Brown & Sharpe; Pratt & Whitney; the Lufkin Rule Company, Saginaw; W. & L. E. Gurley, Troy) who manufacture instruments on the metric system with great precision, and who export them in considerable quantity to Europe. The Bureau of Standards is also equipped to determine metric standards, in addition to those of the customary American system. In fact, it is even better equipped for this purpose, since

[1] Louis A. Fischer and Henry D. Hubbard: "Laws Concerning the Weights and Measures of the United States."

in conformity with the law of April 5, 1893, the American units of measure are defined in numerical ratio to the metric units.

Finally, let us not forget that, in many instances, metric measurements are forced upon manufacturers in the United States unless they withdraw from dealings with European countries and Latin America. The facility with which metric reform can be effected in a factory for the execution of large orders has been clearly demonstrated by the recent example of the Baldwin Locomotive Works, which were equipped with great rapidity for the manufacture of a batch of locomotives ordered to metric dimensions by a French railway company, and which executed the order without any error having been observed.

I have above endeavored to show that it would be practicable for American factories to bring about metric reform in certain mechanical industries entirely by mutual voluntary action. The examples above cited show that such reform is possible by mutual understanding, and that no special legislation is necessary for the purpose. Nevertheless, it is true that if a law of the United States called for the introduction of the metric system into commerce, its introduction into manufacture would become much more simple and rapid. Manufacturers interested in such reform should, therefore, not lose sight of the advantage of legislative action, but if it seems difficult to obtain such action in the near future, it should be quite possible to take the initiative even in individual cases, or at least by mutual agreement among industrial groups.

One argument only, worthy of consideration, has been offered in opposition to metric reform in the discussion. The adoption of the new measures produces in every industrial plant a disturbance which is annoying and sometimes expensive.

The most ardent partisans of metric reform are obliged to admit the validity of this argument, but an impartial examination of the situation indicates, at the same time, that its importance has been greatly exaggerated. Mr. Byrom announced at the Cotton Congress, Manchester, in 1905, that the adoption of the metric system would cost English engineers alone a sum in excess of $500,000,000. The absurdity of such a statement is evident to all those who have followed the progress of metric reform in industrial countries, such as Germany. As for England, it is only necessary to consider that Mr. Arthur Chamberlain, president of Kynoch's, estimates that the adoption of the metric system by his important firm has cost exactly a half of one per cent of profit for a single year, balanced by a marked economy in the year following.[2]

Whatever may be the disturbance caused by the adoption of the metric system in manufacture, it must be clearly recognized that, sooner or later, metric reform must come about, owing to the inevitable law of progress and perfection; and, moreover, that the longer the reform is put off the more expensive it must be, not only because industrial production is constantly increasing, but also because the losses caused by a wasteful system are constantly increasing.

It is also necessary to take into consideration a factor of considerable importance, namely, that the longer metric reform is put off, the longer the Anglo-Saxon countries will find themselves isolated from mutual understanding with other nations in respect to measures. The report which I am forwarding herewith[3] contains a statement of the actual condition of the metric system in the world. It is there shown that the only industrial countries, outside of Anglo-Saxon countries, in which the international metric system is not obligatory by law are Japan and Russia. In the latter countries, however, metric measurements are in rapid development. The metric units introduced into these countries in 1891 and 1900, respectively, have advanced so rapidly that, in Japan, metric units of weights are calibrated 12 times more frequently than the weights of the national system, while in Russia, 250,000 metric weights have been calibrated and delivered to commerce in two years.

Moreover, in China, a preliminary reform in weights and measures has been accomplished during the current year in the direction of the metric system by adopting as a measure of length a unit of 32 cm, the multiples and sub-multiples of which are all decimal, in such a manner that the centimeter is the basis of the new Chinese measurement, which from one end of its range to the other is referred to the centimeter by a simple equivalent in which the significant figures are constant. Thus the metric system has recently penetrated those countries which have been for the longest time connected to secular traditions, and their influence will, apparently, before long markedly affect the coalition of the metric countries. It would be, moreover, an error to suppose that, as has occasionally appeared in recent statistics, the Anglo-Saxon countries are jointly opposed to the metric system. Scientific measures, all the world over, employ to-day no other units than those of the international metric system, which is the same as that of all electric measurements. The American scientist is, without doubt, more familiar with the kilogram than with the pound, and an American engineer can hardly be unacquainted with the gram and the centimeter, which are the bases of his units the volt and ampere, as well as of the joule and the watt, in which latter units the metric connection is perfectly clear. The American exporter cannot be ignorant of the meter and of the kilogram, because he meets them constantly in his regular business. Even within the United States, the purchases by civil or military hospitals are made almost exclusively in the units of the metric system.[4]

Thus the adoption of the metric system appears as the necessary solution of a dualism which is a constantly increasing annoyance. Its future acceptance becomes irresistible before the world pressure in its favor. For commerce, as I have already endeavored to show, compulsory legislation can only bring about benefit, but that is a matter of national action whose limits are beyond the subject of the present debate. Manufacturers can, themselves, however, accomplish a large share of metric reform, which will be beneficial to all, and the time is favorable for initiating it.

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[2] *Nature*, March 14, 1907.
[3] Report upon the Recent Progress of the Metric System.
[4] Laws of April 13, 1894, and of Nov. 21, 1902.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Abstracts of the important articles appearing in the electrical periodical press of the world

Generators, Motors and Transformers.

Parallel Operation of Alternators.—E. ROSENBERG.—A long illustrated paper read before the (Brit.) Inst. Elec. Eng. dealing with hunting troubles in the parallel operation of alternators. The author explained the magnifying effect of the electrical reaction of an alternator on the oscillations produced by those irregularities in the torque diagram which were not taken care of by the flywheel, and he gave some curves which showed the critical values of the flywheel effect for given electrical constants, as a function of the speed. The author pointed out that the dangerous conditions could be avoided by either increasing the flywheel effect or by improving the regulation of the alternator. In very slow-speed engines often the only possible way is to reduce the initial oscillations to the smallest possible value and to apply amortisseurs to the alternator. In the London discussion Stoney called attention to the part played by the governor in causing hunting of turbo-alternators. Clough doubted the value of dampers. The importance of proper valve setting was emphasized by Howe, and Thompson said that one conclusion to be drawn from the paper was that no alternator

should be driven by engines running at less than 100 r.p.m.—Lond. *Electrician*, Jan. 29 and Feb. 5; Lond. *Elec. Eng'ing*, Feb. 4.

Frequency Changers.—Behrend.—To supply a traction system with energy from a lighting network, frequency changers are required. The most important practical case is the transformation from 50 cycles, three-phase, to 15 cycles or 25 cycles, single-phase. If the transformation is always in the same direction, namely, from three-phase to single-phase, the use of non-synchronous machines has certain advantages. But if occasionally transformation is also to be made from single-phase to three-phase, the fact must be taken into account that induction generators always require the simultaneous operation of synchronous generators. In general it will therefore be preferable to use synchronous motor generators. In order to facilitate their connection in parallel and the proper regulation of the distribution of load on several machines working in parallel, the Siemens-Schuckert Company makes one of the four main parts of the motor generator (that is, either one stator or one rotor) displaceable against the other stator or rotor. For most purposes the simplest method is to make one of the two stators displaceable with respect to the other.—*Elek. Zeit.*, Feb. 4.

Transforming Alternating Current into Low-Tension Direct Current.—D. Korda.—An illustrated description of a converter for special application in electrolytic works or other works requiring low-tension direct current, but connected to alternating-current systems. The special feature of the machine designed by Heyland and Korda, and described in this article, is the production of both alternating and direct currents by unipolar induction in the same machine. The principle is stated as follows: "The tension produced in each conductor of the alternating-current winding is not primarily alternating, but pulsating and of constant sign. It becomes alternating only by the method of connecting the conductors in series among themselves. However, the same conductors can be connected in such a way that the pulsations are added together always with the same sign. A pulsating direct current is then obtained. Finally, if the connections are made in such a way that the pulsations are added under a certain phase displacement, a direct current of constant intensity is obtained."—*La Lumière Elec.*, Jan. 30 and Feb. 6.

Lamps and Lighting.

High-Efficiency Incandescent Lamps vs. Carbon Lamps.—C. Leonard.—The first part of what will probably be a long article on the comparison of carbon-filament lamps and the new high-efficiency incandescent lamps. The author first discusses those practical units on which a comparison must be based. In comparing the candle-powers, the spherical candle-power must be used. The author explains the importance of the mean spherical candle-power during useful life, and the mean specific consumption during useful life in watts per mean spherical candle-power. The cost of the mean spherical cp-hour depends on the useful life, the price of the lamp, the price of the kw-hour, the mean spherical candle-power during life, and the mean specific consumption during life. The author begins with a discussion of the carbon-filament lamp. The article is illustrated by diagrams.—*La Lumière Elec.*, Feb. 6.

Tungsten Lamp.—A note on a British patent of W. C. Arsen (17,618, 1908) for a process of making tungsten filaments. It consists in first mixing very finely divided WO_3 with graphitized lampblack and a solution of ceresene, rosin and gilsonite, in benzole. To insure a uniform mixture the product is passed several times through a fine aperture under pressure, and finally squirted through a circular die. The squirted threads are baked at a temperature of about 350 deg. C. to drive off the volatile components. They are then packed in powdered silica in graphite troughs, and fired to a temperature of 1500 deg. C. to complete the reduction and to sinter them together.—Lond. *Elec. Eng'ing*, Feb. 4.

Tungsten Lamp.—An article by H. T. Owens on the progress of street lighting by tungsten lamps in the city of New York; and an article by N. Macbeth on tungsten lamps in a hat-store window.—*Illum. Engineer*, January.

Flame-Arc Lamp.—An illustrated description of a double-electrode flame-arc lamp made by a British company. When the lamp starts up the arc is struck between only the first pair of electrodes, for the second pair is kept further apart than the first by slightly staggering the holes in the striking cradle through which the electrodes of one pole pass, and no arc is, therefore, struck between them. The electrodes are placed in the usual slanting position, and are controlled by shunt- and series-wound solenoids, one at each end of a rocking lever. This lever releases a drum from which the cross-bar, carrying the electrode holders, is suspended by a flexible cord, this latter being automatically wound up by a coiled spring inside the drum when the cross-bar is lifted for trimming. When the first pair of electrodes is nearly consumed the cross-bar carrying them touches one end of a small lever, and, gradually pressing it down, causes a rod which is connected to the other end of the lever to be raised until the controlling gear for the second pair of electrodes comes into action. The change-over, therefore, takes place quite smoothly and is practically imperceptible. The arc is practically at the same point in the globe whichever pair of electrodes is in use. In the continuous-current lamp the electrodes are 9 mm and 8 mm in diameter, respectively, and in the alternating-current lamp they are both 9 mm. The burning hours are 11 for each pair of electrodes, or one lamp burns for 22 hours without retrimming. This lamp will burn two in series on 100 volts, or four in series on 200 volts, or any number in series on a suitable voltage on both continuous- and alternating-current circuits.—Lond. *Electrician*, Jan. 29.

Flame-Arc Lamps.—Some notes on the Jandus "regenerative" flame-arc lamp, which has been on the British market for nearly a year and is now used in about 27 British cities. The burning life varies from 70 to 90 hours, according to the type of lamp, etc., and this length of burning is obtained with one pair of electrodes, which may feed continuously without any break. The longest electrode is 18 in. and of large cross-section, namely, 5/8-in. diameter, and this reduction of length results in a short lamp with an over-all length of only 36 in. The arc is completely enclosed, and no fumes can escape.—Lond. *Elec. Rev.*, Feb. 5.

Flux of Light Method.—E. L. Elliott.—A continuation of his serial, discussing simple calculations from the practice of the illuminating engineer, covering the flux of light principle. The article is illustrated by diagrams.—*Illum. Engineering*, January.

Generation, Transmission and Distribution.

Gas Power.—J. R. Bibbins.—An illustrated description of the Swissvale plant of the Union Switch & Signal Company which is of practical interest as it was one of the very earliest 60-cycle, gas-driven, alternating-current plants installed in this country, yielding eight years' experience to date. Its operation at all times has been representative of the average industrial plant on 24-hour service. The results of this long experience are summed up as follows: The modern gas engine, properly operated, is fully equal to industrial power service even with alternating-current distribution. Eight years' experience points to a normal depreciation rate on the vertical type, with every indication of an equally satisfactory future for the horizontal type of engine. The operation of either the horizontal or the vertical type presents no greater difficulties than does a good steam engine, and requires about the same extent and grade of attendance. In double-acting designs ample security is provided against careless operation by automatic oiling and duplicate igniters. The necessary uniformity of combustion is assured. Cost of energy generation, with all charges included, is relatively low; it is well below steam. Regulation is suited to demands of direct-current or alternating-current parallel operation. Speed variation is within present requirements. Angular deviation is well below that of steam engines, with sufficient factor of safety to cover ordinary contingencies. The success of solid-coupled, 60-cycle plants is practically assured for general commercial service.—*Electric Journal*, February.

Application of Motors.—H. W. Peck.—An illustrated article on the selection of electric motors for industrial purposes. The

first thing to consider is the power requirement of each machine individually. It is important, especially in old plants which are being modernized, to examine each machine with the idea of replacing it if possible with a new machine of enough greater sufficiency to warrant the investment and with the idea of correcting mistakes in operation which may have crept into practice insidiously and remained unnoticed. Of prime importance is the matter of speed variation, as it determines the choice between the direct- and alternating-current systems, if both forms of energy are available from the central station. The author discusses briefly the special features of various types of motors for different purposes and then speaks of individual and group drive. Individual drive is correct when, 1, the cost of installation is less than for a group drive; 2, when the saving in operating cost of the individual drive is more than enough to pay the additional fixed charges of this form; 3, when the convenience of operation is worth the additional cost which may be involved. The discrepancy in cost between group and individual drive is not as great as might at first be supposed. The saving in operating cost of individual drive depends on: 1, the difference in fixed charges, usually in favor of group drive; 2, the difference in efficiency of the motors, which is in favor of the large group motor if run at high average load, otherwise in favor of the smaller motors well loaded when running at all; 3, the number of bearings, loose pulleys, belts and gears eliminated by the use of individual motors; 4, the average hours daily use of machines.—*Electric Journal,* February.

Electricity in Metallurgical Works.—E. W. LEHMANN-RICHTER.—The author gives a comparison of the losses with mechanical transmission and electrical transmission in large metallurgical works. He then describes the method used in the lead and silver works of Braubach for determining the power consumption of the various machines. He describes in detail the various systems of group driving and individual driving employed in these works. Electric motors are used for crushing, traction, elevators, blowers, exhausters and compressors.—*Elek. Zeit.,* Feb. 4.

Energy Distribution.—G. L. ADDENBROOKE.—His concluding lecture on energy supply in Great Britain. The author commences by describing the modern distributing system. In connection with the protection of mains he advocates the adoption of the balanced transformer system. With regard to future developments, he looks forward to the time when the gas engine, supplied with gas from producers consuming bituminous coal, will be able to compete successfully with the steam engine. Such a development, however, can be retarded, in his opinion, by effecting further economies in steam plant. In concluding, the lecturer dealt briefly with the legal position.—Lond. *Elec. Eng'ing,* Feb. 4.

Electric Motors in Railway Shop.—An illustrated description of the electrical equipment of a large railway workshop in India. The plant was recently electrified, the aggregate rating of the motors being 2000 hp. The present generating plant consists of two 125-kw and two 250-kw sets. Three additional sets, of 375 kw each, will shortly be in operation. Energy is supplied on the three-wire system with 440 volts across the outers, to which nearly all the motors are connected. The 220-volt supply is reserved for lighting, fans, a few small motors and some portable electric drills. Two balancers, each capable of dealing with an out-of-balance current of 50 amp, are installed. —Lond. *Elec. Rev.,* Jan. 29.

Energy Cost.—H. S. KNOWLTON.—An article on the cost of generating electrical energy during four succeeding years in a New England central station of about 5000-kw rating. The equipment consisted in 1905 of 10 generators ranging in rating from 135 to 675 kw and driven by steam engines. In 1908 a 2000-kw steam-turbo-generating set was installed. The cost of generating electrical energy during the four years is summed up from the article, as far as possible, in the accompanying table. The total operating cost given in the last column includes the cost of fuel, rentals, station, real estate, oil and waste water, wages for stations, station repairs, steam-plant repairs, electrical-plant repairs, and of the station tools and appliances. The table shows a progressive increase in the cost of coal, and, as an offset, a considerable increase of the motor load of the station from year to year. No information is given on capital investment, interest or amortization.—*Power,* Feb. 9.

Year.	Cost of coal.	Fuel consumption per kw-hour, lb.	Kw-hour generated.	Kw-hour sold for industrial purposes.	Fuel cost per kw-hour, cent.	Wage cost per kw-hour, cent.	Total operating cost per kw-hour, cent.
1905	$4.28	3.29	5,354,000	1,409,000	0.63	0.318	1.30
1906...	4.42	3.09	6,038,000	1,772,000	0.61	0.286	1.18
1907...	4.55	...	.....	2,196,000	0.635	0.247	0.975
1908...	4.75	3.35	9,426,000	3,760,000	0.71	0.262	1.06

Ventilation of Mines.—A. H. STOW.—A paper discussing the relative advantages of pressure fans and exhaust fans for mines. While the general preference is now for exhaust fans, the author endeavors to show that pressure fans have distinct advantages. —*Bull. Am. Inst. Mining Eng's,* February.

Brakes.—J. C. RENNIE.—An abstract of a paper read before the Northampton Institute Engineering Society. The stopping distance for a car is proportional to the square of the speed and is inversely proportional to the friction coefficient. With the present tendency to increase speed it is important to seek improvement in the study of friction, with a view to increasing the coefficient of friction. The author suggests a method of measuring more accurately and satisfactorily the coefficient of friction of the brakes on a tramcar. The ordinary method of loading a track brake on a truck and drawing it at various speeds, measuring the drawbar pull, is admittedly unsatisfactory, and impossible at high speeds. The proposal is to obtain a curve giving the variation of the friction coefficient with speed directly from an accelerometer. The simplest form of accelerometer is a simple pendulum which can oscillate in the plane of the car's motion. When the car is accelerating or retarding, the pendulum will be displaced proportionally to the acceleration or retardation. The car is run up to any required speed, the power shut off and the brakes applied until the car comes to rest. If a retardation curve has been taken from the instrument, for the car coming to rest under running friction alone, the difference of the curves gives the retardation due to the brakes. This retardation is the product of the load on the shoes and the coefficient of friction. If the load is constant, the curve finally obtained is a curve of the friction coefficient. The scale could readily be calibrated to give direct readings of the coefficient of friction by selecting a suitable length for the pendulum. The instrument could be made very delicate if required, for a pendulum 32 in. long will give a movement of approximately 1 in. for an acceleration of 1 ft. per second per second. The coefficients could on this scale be read directly to the second significant figure without difficulty. This instrument would also be useful for determining the comparative states of different rails for greasiness, and would probably be very convenient in the training of drivers.—Lond. *Elec. Engineer,* Feb. 5.

Definition of Acceleration.—C. O. MAILLOUX.—A paper read before the International Electrical Congress at Marseilles on the industrial definition of train acceleration. The author defends the use of the miles-per-hour-per-second unit for the calculation of train acceleration, as against the unit of feet-per-second-per-second.—*Elec. Railway Jour.,* Feb. 13.

Convention.—An account of the proceedings of the annual meeting of the Central Electric Railway Association, held in Indianapolis on Jan. 28, together with an account of the proceedings of the Central Traffic Association meeting held on Jan. 27, and reprints of two papers presented, one by W. E. Rolston on the proper installation and equipment, and the other by G. H. Kelsey on operating lamps and motors upon railway circuits.—*Elec. Railway Jour.,* Feb. 6.

Meter and Relay Connections.—H. W. BROWN.—A continua-

tion of his long illustrated serial. In the present installment the author deals with three-phase, four-wire circuits and discusses the method of grouping and the connections of the wattmeter and power-factor meter, and of the voltmeters and ammeters. The minimum number of meters and meter transformers, for a three-phase, four-wire circuit, is always as great, and sometimes greater, than is required for a three-wire circuit. One single-phase wattmeter or power-factor meter is not suitable for the entire circuit, because a four-wire circuit is usually unbalanced, and the unbalancing would affect the accuracy of these instruments. Three series transformers are required on four-wire circuits for use with wattmeters, power-factor meters or ammeters, if measurements are to be made on all the phases. Three shunt transformers must be provided if it is required to measure the e.m.f. from each line to neutral and also between any two non-neutral—main—lines. Three shunt transformers are required—whether the e.m.fs. to neutral are to be measured or not—if a wattmeter is also to be used in addition to the voltmeters measuring the e.m.fs. between all of the non-neutral lines. If the e.m.f. from only one or two lines of the neutral and the e.m.f. between only one pair of main lines is required, only two shunt transformers are necessary for both the voltmeter and the wattmeter. A grounded neutral system must be treated as a four-wire circuit, if any current returns through the ground, the currents in the other lines would be the same as if it were returning through a neutral line. Sometimes a system is grounded or has a neutral line in one part of the circuit, but has no connection to ground or neutral in another part. At all points between the connections to ground or neutral, the system must be considered as a four-wire circuit, but at other

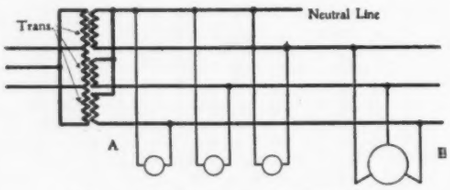


FIG. I.—DIAGRAM OF CONNECTIONS.

points connections may be made for either a three-wire or a four-wire circuit. A common arrangement of this kind is to have one side of the transformers delta-connected and the other side Y-connected. Three lines are brought out from the delta-connection and four from the Y-connection. In Fig. 1 the middle portion is a four-wire circuit having Y-connected transformers with a neutral line brought out from the common transformer connection. This part must be treated as a four-wire circuit. The left-hand part is delta-connected, and the right-hand part has no connection to the neutral. Both the left-hand and right-hand parts may, therefore, be considered as three-wire circuits. *A* represents any single-phase or three-phase apparatus connected to the neutral, while the apparatus at *B* has no neutral connection.—*Electric Journal*, February.

Electric Installation in Mines.—A set of regulations for lamp and motor installations in mines, proposed by the German Association of Electrical Engineers.—*Elek. Zeit.*, Feb. 4.

Wires, Wiring and Conduits.

Wiring of Buildings.—D. S. Munro.—A paper read before the Glasgow section of the (British) Inst. Elec. Eng. The author reconsiders the various familiar methods of wiring, with their advantages and troubles, as a reminder that no really good and cheap method of indoor wiring has yet been invented and that the subject is worthy of persistent attention and effort. It is quite possible that there will be a return to lower consuming voltages coincident with the development of high-tension transmission. With pressures of from 25 to 100 volts the wiring precautions can be very materially reduced, and cheap methods of wiring would have a fair chance, notwithstanding the increased size of indoor cables; the increased efficiency of lamps is of assistance. Whether present pressures be changed or not, there is a demand for a cheaper system of wiring. Until the advent of good, cheap wires fit for drawing-in uncovered, like gas pipes, the choice will be limited. Iron or steel conduit has not much in its favor. If wiring must be concealed, what is wanted for branch wires is cable, with its metallic protection complete, manufactured in long lengths and delivered in coils, and soft enough to unwind, bend and straighten easily. With such a cable it would be a pity not to use the continuous metal covering as the neutral wire in town work, or as, say, a negative in isolated work. With such a metal covering, enameled, run in dry places and on insulating studs in damp places, the leakage risk would be small, seeing that the external metal would be so nearly at earth potential. Architects in designing buildings should provide better paths for electrical conductors. —Lond. *Electrician*, Jan. 29.

Compound Wire of High Self-Inductance.—An abstract of a British patent (13,678, 1908) of A. Wolff. Many attempts have been made to produce a conductor which shall have great self-induction, but shall not be subject to the action of the skin effect. Pupin coils inserted with this object have not always been successful owing to a reflex action and the sensitiveness with respect to magnetic influence. Compound conductors of copper and iron have also proved impracticable. According to this invention it is proposed to use a conductor comprising a magnetic steel core and a non-magnetic manganese steel outer case, or alternate layers of magnetic and non-magnetic steel.—Lond. *Elec. Eng'ing*, Feb. 4.

Fuses.—The conclusion of the first part of his long illustrated article on the historical evolution of the construction of fuses, with recommendations to standardize a certain type.—*Elek. Zeit.*, Feb. 4.

Electrophysics and Magnetism.

Photo-Electricity.—J. A. Fleming.—The author first describes a convenient method of preparing a suitable specimen of a highly photo-electric potassium-sodium alloy. This is contained in a glass tube, connections to the outside being made by means of platinum wires. In the same glass tube, but isolated from the alloy, there is a platinum strip, also connected to the outside by means of platinum wires. Various experiments with this arrangement are described. If the tube is supported in a horizontal position, an electric arc contained in a projection lantern, equipped with the ordinary condenser lens, can be so placed and tilted downward as to converge on to the brilliant mercury-like surface of the pool of alloy a very concentrated beam of light. If, then, the platinum plate and the alloy are connected by means of wires with a sensitive mirror galvanometer, it is found that the impact of the light upon the surface of the alloy not merely facilitates the escape of negative electricity from it, but actually creates an e.m.f. and current in the galvanometer circuit, which is in such a direction as to indicate that negative electricity is caused to move, by the action of the light, through the vacuum from the surface of the alloy to the platinum plate. The physical operation of this photo-electric cell is not identical with that of an ordinary voltaic cell, since the current is in opposite direction. By using two such cells in series the author finds that the separate photo-electromotive forces are additive, and that if such photo-electric cells are joined in series like voltaic cells and separately illuminated, the individual e.m.fs. are added together in an external circuit connecting the first and last plate. In the case of two tubes giving separately 0.45 and 0.6 volt e.m.f., the e.m.f. when in series was found to be 1.0 volt. The effective rays producing the photo-electric effect are the most refrangible ones of the visible spectrum. In the experiments the ultraviolet rays had been considerably filtered out from the radiation. If a very thin film of gelatine stained with a yellow dye or a sheet of ordinary yellow glass is interposed in the path of the incident light, the deflection of the galvanometer drops almost to zero. The same reduction is effected by a sheet of ruby glass or a gelatine film stained red. A green glass cuts off a good deal of the deflection, but a sheet of cobalt glass reduces it only to about two-thirds, showing that the blue glass is fairly transparent to those rays which can produce this e.m.f. The most electro-positive metals are the most highly photo-electric substances. The ionized gas over the illuminated alloy has a unilateral conduc-

tivity, and will conduct the current from a voltaic cell in one direction, but not in the opposite. Negative electricity can be conveyed from the alloy to the platinum across the rarefied air space, but not in the opposite direction. Hence, an alternating current, whether of low or high frequency, can be rectified, and by interposing such a light-cell in the circuit of a galvanometer, in which circuit high-frequency oscillations are also created by the inductive action of a discharging condenser, the author has been able to rectify these oscillations. The action, however, proved to be much more feeble and irregular than the similar rectifying effect which can be produced by a glow-lamp. The effect is much influenced by temperature, being increased by heating the alloy and by exposing it to powerful radiation for some time.—*Phil. Mag.*, February.

Nature of Alpha Particles.—E. RUTHERFORD AND T. ROYDS.—The experimental evidence collected during the last few years has strongly supported the view that the alpha particle is a charged helium atom, but it has been found exceedingly difficult to give a decisive proof of the relation. The authors have made experiments to test whether helium appears in a vessel into which the particles have been fired, the active matter itself being enclosed in a vessel sufficiently thin to allow the particles to escape, but impervious to the passage of helium or other radioactive products. The experiments give a decisive proof that the particle after losing its charge is an atom of helium. Other evidence indicates that the charge is twice the unit charge carried by the hydrogen atom set free in the electrolysis of water.—*Phil. Mag.*, February.

Secondary Radiation.—L. T. MORE AND R. E. C. GOWDY.—An abstract of an Amer. Phys. Soc'y paper, in which they report on the continuation of their researches on the secondary radiation given off by metals, bombarded by Roentgen rays. To account for the secondary radiation, J. J. Thomson has advanced the theory that the X-rays effect a disintegration of the atomic structure of the metal and permit the expulsion of charged corpuscles. The present authors' experiments make this theory doubtful. Iron, lead and copper plates, with pure surfaces, were used, and then the plates were coated with thin films of the lower oxides of the metal and again with films of the higher oxides. The effect of this successive oxidation on the fatigue seems to show that chemical changes of the surface produced by the X-rays with the consequent changes of the surface electrified double layers will account for the phenomena observed.—*Phys. Rev.*, February.

Units, Measurements and Instruments.

Instruments and Tests.—An illustrated description of various instruments made by Siemens Brothers & Company, and arrangements for testing. A method is described for obtaining various power factors, and for testing wattmeters at all loads without waste of power. A direct-current motor is mechanically coupled to two alternating-current generators, one of which feeds energy to the pressure circuits and the other to the current circuits. The field magnets of both generators are controlled by rheostats at the testing table, and the direct-current motor is supplied with energy from a set of accumulators having a rating of 240 amp-hours at 500 volts, so that a constant speed can be maintained over a long period. The speed of the motor is controlled by field regulation, giving a range of frequency from 20 to 120 cycles per second. The stator of one of the generators is mounted so as to be capable of rotation through an angle of about 100 deg., the movement being effected by means of a small motor driving through worm gear, so that it is possible to produce any desired phase angle between current and pressure, giving a range of power factor from zero to unity with infinitesimal gradations. This operation is controlled entirely from the testing table, the motor-generator requiring no attention. Wattmeters are required not only to give correct indications at all loads within their range at usual values of the power factor, but also to read absolutely zero when supplied with the maximum current and pressure at zero power factor. Among the numerous instruments which are described in the article there is the Hopkinson-Thring torsion meter, which has special application to turbines, but can be used for measuring the power transmitted through any shaft. The principle of the instrument depends upon the observation of the relative motion between two rays of light projected upon a scale from mirrors, which revolve with the shaft, and throw a practically continuous line of light across a scale, even at moderate speeds. One mirror is fixed relatively to the shaft, while the other is deflected proportionately to the torsion between two points on the shaft at a fixed distance apart, the distance between the two lines of light being a measure of the torsion in that length of shaft. Various pyrometers are also briefly described.—Lond. *Elec. Rev.*, Jan. 29. A detailed illustrated description of the Hopkinson-Thring torsion meter is given in Lond. *Electrician*, Feb. 5.

Hysteresis Coefficient.—G. W. MEYER.—An article recommending the method of Stahl for determining the Steinmetz coefficient of hysteresis (*Electrical World* Nov. 21, 1908, Vol. LII, page 1122).—*Elek. u. Masch.* (Vienna), Jan. 24.

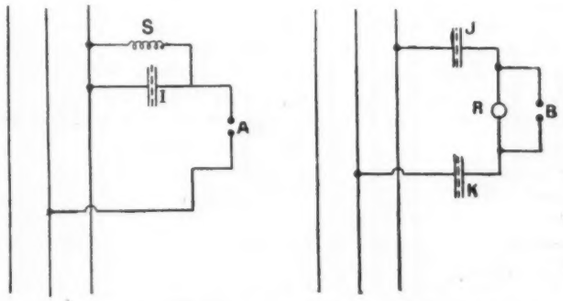
Radioactivity.—W. WILSON.—An account of experiments on the radioactive products present in the atmosphere, with an estimate of the amount of thorium present in the earth's crust.—*Phil. Mag.*, February.

High-Pressure Gage.—P. W. BRIDGMAN.—An abstract of a paper read before the American Physical Society. An experimental investigation of the suitability of the secondary gage proposed by De Forest Palmer, making use of the variation of electrical resistance of mercury. Measurements were made by De Forest Palmer to 2000 kg per square centimeter with a probable error of about 1.6 per cent in the pressure which might be deduced from the resistance measurement. The present author has tested the mercury gage over a wider range and with greater accuracy. He finds that the gage shows no hysteresis and is capable of indicating a pressure of from 500 kg to 6800 kg per square centimeter with an accuracy of 1/10 per cent. The greatest source of error in actual use is the irregular action of the glass capillary containing the mercury. The glass must be seasoned by repeated subjection to pressure before its indications become regular. The glass must be reseasoned if subjected to large changes of temperature. It was found that an easily fusible glass in which the strains left from drawing are small gives the most regular results.—*Phys. Rev.*, February.

Induction Meter.—An official communication by the Reichsanstalt by which a single-phase induction meter of the German Westinghouse Company is admitted for calibration.—*Elek. Zeit.*, Feb. 4.

Telegraphy, Telephony and Signals.

Sending of Telegraph Signals over Energy Transmission Lines.—L. NEW.—A description of a system for using the wires of an energy transmission line for sending signals from the generating plant to substations, etc. The system is based on the super-position of a high-frequency current on the wire current. The transmitter is shown in Fig. 2, where *A* is a spark-gap,



FIGS. 2 AND 3.—TELEGRAPHING OVER TRANSMISSION LINES.

I a condenser, and *S* an induction coil. *S* arrests the high-frequency current produced by the spark-gap, while the condenser *I* arrests the low-frequency current of the line. The arrangement of the receiving station is shown in Fig. 3, where *B* is again a spark-gap. *J* and *K* are condensers; *R* is a hot-wire relay or another type of relay, which on the arrival of a high-frequency current closes an auxiliary circuit containing a

bell, etc. It is also possible to get visible signals by passing a strip of paper along the spark-gap *B* so as to get impressions of the spark. In order to send signals over the line, the spark-gap *A* at the transmitting station is adjusted to get sparks and produce high-frequency oscillations. Their duration depends on the adjustment of the spark-gap, and it is possible to send signals of variable duration over the line, such as Morse signals. Fig. 4 shows the continuation of a transmitter and receiver. The switch *G* is used for changing transmitting to receiving. Instead of using two line wires, as shown in the illustrations, it is possible to employ one line wire and an earth return.—*L'Industrie Elec.*, Jan. 25.

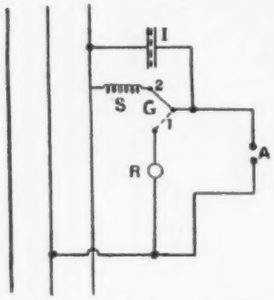


FIG. 4.—TELEGRAPHING OVER TRANSMISSION LINES.

Miscellaneous.

British Exports and Imports.—Diagrams showing the monthly imports and exports of electrical machinery in Great Britain. The curves show an increase of the exports, while the imports are shown to have remained about steady.—Lond. *Elec. Rev.*, Jan. 29.

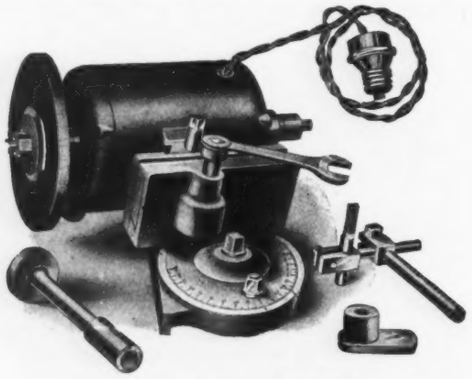
Feed Water.—J. B. C. Kershaw.—An abstract of his paper on purification of feed water. The author deals with methods of detecting and eliminating various scale-forming and corrosive impurities and with the subject of oil separation.—Lond. *Elec. Eng'ing*, Jan. 21.

Steam.—F. R. Low.—An article illustrated by diagrams on the amount of energy in a pound of steam. The author shows at some length why the net energy of expansion from 150 lb. down to atmospheric pressure goes to approximate the energy from atmospheric pressure down to 27½ in. of vacuum.—*Power*, Feb. 2.

NEW APPARATUS AND APPLIANCES

Electric Grinder for Machine Tools.

The Anderson Electric Machine Tool Company, 1113 Cass Avenue, St. Louis, Mo., is making a grinder for the centers of machine tools and similar applications, which is illustrated herewith. It consists of a small ½-hp motor of light weight, direct-connected to an emery wheel. It is so mounted as to be easily attached to a lathe or other machine tool. The base-plate of this device has an angle extending downward and resting against the side of the compound rest of the lathe. This



GRINDER FOR MACHINE TOOLS.

brings it square with the compound rest. When the binding post is tightened so as to hold the machine firm on the rest, any angle desired can be obtained by adjusting the graduated swivel in the base-plate. The horizontal dovetail slide has a gear rack which meshes with the pinion, the pinion being turned by a wrench. This makes a handy device for moving the grinding wheel back and forth against the work being ground. It is claimed that this machine can be attached to a lathe and a set of centers dressed in 10 minutes. The emery wheel can be removed and extension mandrels applied for internal grinding.

Enclosed Fuses.

The Crescent Company, 103 West Adams Street, Chicago, has placed on the market a type of enclosed fuse in which the cartridge containing the fuse element is separate from the end terminals, so that when a fuse has "blown" a new cartridge can be inserted without renewing the terminals. The fuse is equipped with an indicator that is claimed to be thoroughly reliable. A small German silver wire passes along the entire length of the fuse, under the label on the outside of the cartridge and coming through the label at the center of the cartridge. To this is attached a small glass bead; when the fuse blows the bead drops off, thereby showing at a glance that the fuse has blown. Each cartridge has its own indicator, so that when a burned-out cartridge is replaced with a new one, the fuse is ready for service. It is stated that in all of the tests made upon the fuses there has not been one failure to indicate.

The cartridge is a fire-proofed tube with the fuse element passing through the tube; the tube is filled with a non-conducting powder which absorbs the shock and gases, and quenches the arc. The ends are closed with metal caps, which are riveted into the tube.

Sodium for Drying Transformer Oils.

In order for the insulation of transformer oil to retain a high value it is necessary to exclude moisture. Several methods are in use for dehydrating oil, one of the latest to be developed involving the use of metallic sodium, which reacts with water to form caustic soda and hydrogen. In using the sodium process, the oil to be treated is put into an open tank or barrel, the sodium being added initially in the proportion of about one ounce per barrel. The evolution of much hydrogen will furnish conclusive proof that there is much water in the oil, and the balance of the sodium should be added carefully and in small amounts. The amount to be added depends upon the oil, but as a rule 1 lb. to the barrel is usually much more than is required. The oil is then stirred up three or four times a day for a minute at a time. After several days the oil may be removed and tested, but the longer it remains over the sodium the better the insulation of the oil becomes.

According to a second method sodium in the form of sticks is placed in a cylinder of iron wire suspended in the oil. It is said that this method may be used while the transformer is in active service. Metallic sodium is handled by the Roessler & Hasslacher Chemical Company, selling agent for the Niagara Electrochemical Company, the manufacturer.

Asbestos-Covered Magnet Wire.

The Heany Fire-Proof Wire Company has placed on the market asbestos-covered magnet wire which is claimed to possess characteristics which render it valuable for use with traction motors, crane motors, rolling-mill motors, arc lamps.

lifting magnets, blow-out coils, transformers, etc. The wire is surrounded with a wrapping of asbestos having a thickness approximately equal to that of a cotton covering, which is said to be able to withstand even a greater temperature than the wire. It is stated that use is made of pure asbestos, which does not deteriorate.

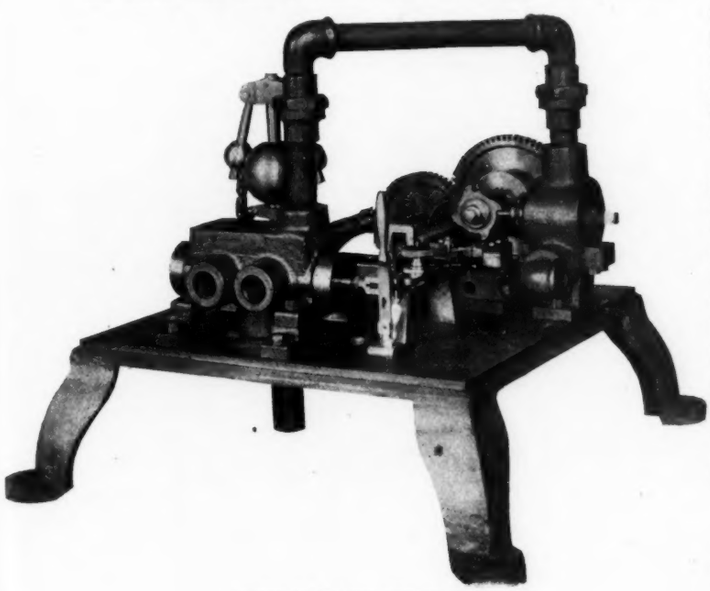
In tests made at the Bureau of Standards, in Washington, it was found that a 0.005-in. thickness of asbestos wire-covering of the non-waterproof type punctured at from 485 volts to 665 volts, while a 0.006-in. covering of moisture-proof material punctured at from 555 volts to 850 volts. The insulation resistance of a 5-in. length of the waterproof covering on a wire 0.081 in. in diameter, when immersed in water, varied from 970,000 ohms to 20,200 ohms, according to the length of immersion. The insulation resistance of a 4-ft. length of non-waterproof covering of a wire 0.091 in. in diameter was found to vary from 13,000 ohms to 40,000 ohms, according to the duration of the test.

Tests made at the New York Navy Yard showed that, when the asbestos-insulated wire was subjected to full-load current continuously for three weeks, the insulation remained intact and unaffected. Current which could be carried for one hour without any apparent effect on the asbestos covering charred the insulation of double-cotton-covered wire within 10 minutes. The asbestos insulation has been recommended by the commandant as a substitute for cotton-covered magnet wire used in the repair and manufacture of apparatus at the Navy Yard

The factory of the Heany Fire-Proof Wire Company is at York, Pa., its main office being at 25 Broad Street, New York.

Impulse Water-Wheel Governor.

There are in use two general methods for governing the speed of impulse water wheels, namely, by partial deflection of the jet from the buckets of the water wheel and by varying the cross-section of the jet. Each method varies the power applied to the wheel and each possesses both advantages and disadvantages. Jet deflection, although wasteful of water, possesses the advantage of introducing neither shock nor ram into the water column. Cross-sectional variation is highly economical in water consumption, but it subjects the hydraulic system to severe shocks.



IMPULSE WATER-WHEEL GOVERNOR.

The governor illustrated herewith uses a combination of the deflection and the variation methods of control; the former to respond instantly to changes in the load without affecting the equilibrium in the pipe line and the latter to adjust and restore conditions to the greater operating efficiency which results from the prevention of the waste of water. In its construction especial effort has been made to reduce to a minimum the time-interval in operation and to eliminate hunting. Its principle is that of a centrifugal apparatus connected with a distributing valve for operating a piston that controls the jet, this distributing valve being manipulated by a lever with an adjustable fulcrum in such a way as to give maximum acceleration to its action in successive and distinct steps which cease to advance —or recede—upon the instant when the speed of the water wheel has been restored to normal.

The above described governor has been placed on the market by the Bailey Mfg. Co., 102 Battery Street, San Francisco, Cal.

Variable-Speed Electric Drive for Paper Machines.

What is said to be the first Fourdrinier paper-making machine to be driven by individual electric motors on the various parts has just been placed in operation by the Gould Paper Company, at Lyons Falls, N. Y. The electric motors have been used to overcome the difficulties caused by the exacting speed requirements of a paper machine, and the results show that the arrangement is far superior to the complicated belt, shafting and gear systems previously used to obtain similar results.

In the process of manufacture there are numerous difficulties encountered in maintaining a continuous sheet of paper on account of the inconsistency of the stock, the irregularities of the mechanism, the elongation of the webb due to pressing and the shrinkage in the drying process, and lastly, and very important, in regulating the driving mechanism so as to allow for the contraction and expansion of the sheet of paper in passing over the machine.

It is sometimes a matter of tedious adjustment on the part of the machine operator to get the "draw" of paper between the several sections adjusted so that the webb of paper will run the longest possible time without breaking, because there is a considerable loss of time and material when a break occurs.

If constant speed were the only requirement, synchronous alternating-current motors might have been adopted to solve the problem. There is the added complication, however, that all classes of paper are not made at the same speed. At the Gould Paper Mill, for instance, newspaper is made at a high speed, and a heavy bag paper is also manufactured which requires a very low speed.

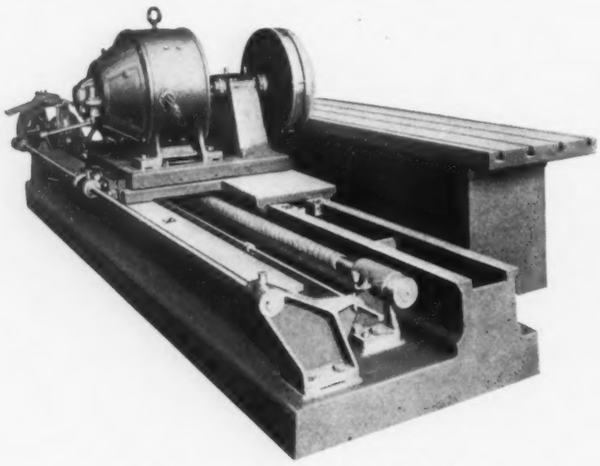
The system installed for the Gould Paper Company was designed by the Standard Engineering Corporation, of Wilmington, Del., and Philadelphia, Pa., assisted by the engineers of the Crocker-Wheeler Company, of Ampere, N. J., which handled the intricate electrical problems involved.

It is said that by means of the direct-current motors employed the system can be operated at any speed to accommodate any kind of paper. The motors, once adjusted to uniform speed, will remain in adjustment indefinitely. The generating plant and all the motors for the drive were furnished by the Crocker-Wheeler Company, of Ampere, N. J.

Motor-Driven Traveling Head Face Grinder.

The type of traveling head grinder illustrated herewith, known as a face grinder, is particularly adapted to the work of structural iron workers, bridge builders, safe makers and manufacturers in kindred lines, where it is necessary to grind to very exact figures any materials that are liable to be too hard to be machined, such as beams, columns, steel safe plates, cast-iron floor plates, iron staircases, cast-iron fences and railings. As shown in the illustration, the grinding head is direct-connected to an electric motor, which, together with a very heavy outboard bearing, is mounted on a large base moving on ways. The motor has an extended shaft to carry the grinder chuck. The work is stationary, being bolted to the large platen in front of the 22-in. emery ring, while the ring rotates and also moves slowly back and forth from end to end of the platen. The reversing is done by a hand lever when the machine is in use, but automatic stops are provided at each end of the extreme travel

to prevent over-travel should the attendant neglect to reverse the feed. The maximum traverse feed of the grinder is ½ in., and is operated by a hand wheel and mitre gear on the splined shaft in the front of the machine. The longitudinal travel of the grinder is obtained from the powerful feed-screw shown in the illustration. The travel of 20 ft. per minute is somewhat faster than might be supposed from the thread of the screw, as



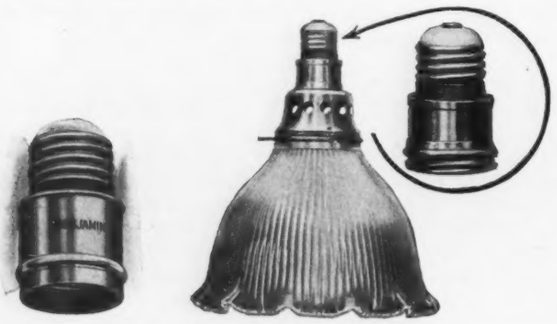
MOTOR-DRIVEN TRAVELING HEAD FACE GRINDER.

a triple thread is used. The lead screw is driven by a second motor, not shown in the illustration.

The grinder is driven by a standard Westinghouse type compound-wound, direct-current, 10-hp, 1100-r.p.m. totally enclosed motor. Where required, an alternating-current motor may be used in place of the direct-current motor. The size of the motor to operate the lead screw is dependent upon the nature of the work to be performed—that is, the amount of metal to be removed. This grinder is a 102-in. face grinder as manufactured by the Diamond Machine Company, of Providence, R. I.

Benjamin Extension Socket.

It frequently happens that it is desired to use reflectors over lamps which are in ceiling receptacles. Sometimes these receptacles are sunk some distance below the surface of the plastering so that it is impossible to attach a shade-holder. Even if the receptacle is not sunk flush with the plastering, the ordinary type of receptacle is not suited to taking a shade-holder. If the receptacle is of porcelain there is no way of attaching the holder to the porcelain, and if it is of the kind in which a composition ring holds on the receptacle casing, it is dangerous to attempt to attach a shade-holder, because this

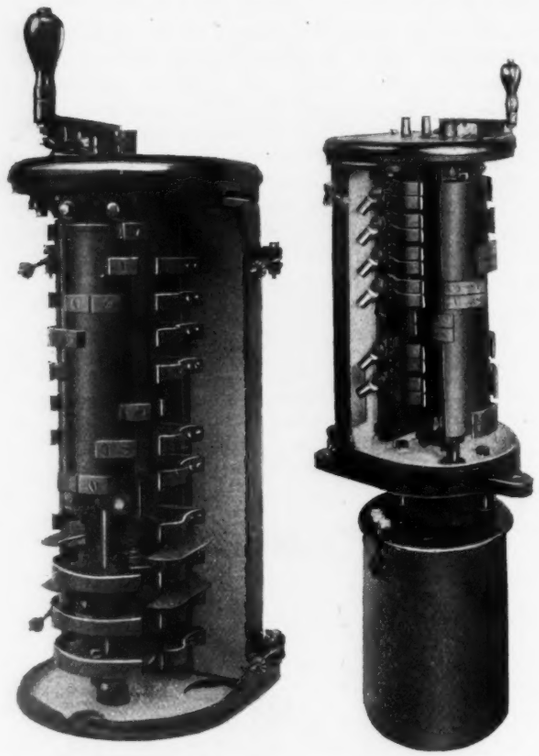


FIGS. 1 AND 2.—EXTENSION LAMP SOCKET.

ring will soften with the heat of the lamp and it is likely to let the holder and reflector or globe drop on the lamp. If the lamp breaks or pulls out of its base, as it is likely to do in such an event, the whole combination drops to the floor. The Benjamin Electric Manufacturing Company, of Chicago, has brought out a new specialty called the "Benjamin Socket Extension," the construction of which is evident from Figs. 1 and 2. It is simply an extension plug carrying a receptacle. The shell is the same shape as a standard socket shell, so that it easily takes any standard shade-holder. This extension increases the length of the socket or receptacle 1.25 in.

Controllers for Slip-Ring Induction Motors.

The accompanying illustrations show two forms of reversible drum-type controllers for slip-ring induction motors. The form illustrated in Fig. 1 is intended for rotors using not over 80 amp at 280 volts, while the one shown in Fig. 2 is suitable for rotor currents up to 400 amp and e.m.fs. not exceeding 500 volts. Each controller is equipped with a three-pole primary switch, a combined line and reverse switch and a cylinder for



FIGS. 1 AND 2.—CONTROLLERS FOR SLIP-RING INDUCTION MOTORS.

controlling the secondary starting and regulating resistance, all of which are operated by one lever. In the controllers of larger rating the primary switch is immersed in oil, as indicated in Fig. 2. The resistors are of the cast-metal grid type, compactly mounted for convenient installation. These controllers are made by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

General Electric Wiring Supplies Building.

The General Electric Company has recently completed, at Schenectady, a large building specially designed for the manufacture of wiring supplies of all kinds. The building is four stories in height, 400 ft. long, 85 ft. wide at its narrowest part, and has a total floor space of about 150,000 sq. ft. Reinforced concrete was used throughout in the construction. All partitions are of reinforced concrete with asbestos wood trim and for double assurance the interior is equipped with a fire-extinguishing sprinkler system. Enclosed arc lamps, with large corrugated reflectors, furnish a well-diffused light during the late hours of the day, ample natural illumination being afforded by numerous windows on each floor. All machinery within the building is, of course, driven by electric motors.

which in a great many cases are directly connected to the machine.

The boxing and shipping department occupies the first floor, which has a track for freight cars. The second floor is occupied by the mechanical department. Machinery for the production of dies, tools, molds, etc., are grouped on one part of the floor, while presses for punchings, metal cases, etc., are placed elsewhere. Other machinery on this floor are automatic screw

ASSEMBLY FLOOR, WIRING SUPPLIES DEPARTMENT BUILDING.

machines, drilling, tapping, stamping, spinning machines, etc. Part of the floor is divided off for polishing, dipping and plating operations.

The third floor is occupied by the assembling department, which is devoted entirely to the building up of the numerous parts into a complete and finished article ready for boxing and shipping. There are accommodations and facilities for about 1000 operatives in this department. The assembling operations are divided into several divisions, the main sections being for sockets and receptacles, cut-outs and attaching plugs, fuse plugs, small knife and snap-push button switches, enclosed and open type fuses, distribution cabinet panels, etc. Sealing and pitching operations are also here performed and the assembled devices placed in boxes and labeled.

The fourth floor contains the offices of the managing engineer and his force of designing engineers, draughtsmen, production and costs clerks. On this floor there are also facilities for electrical and mechanical testing of the completed devices and for the production of models. A force of model makers is daily engaged in making up preliminary models, in which the molds, dies and tools are formed for the production of the finished article.

The productive capacity of the building at maximum output is about 1,500,000 complete and separate devices weekly, representing all types of sockets and receptacles, cut-outs, fuses, magnetic blow-out fuses, switches for open and concealed wiring, knife-blade switches, cabinet panel boards, etc.

Feeding Device for Boiler-Tube Cleaner.

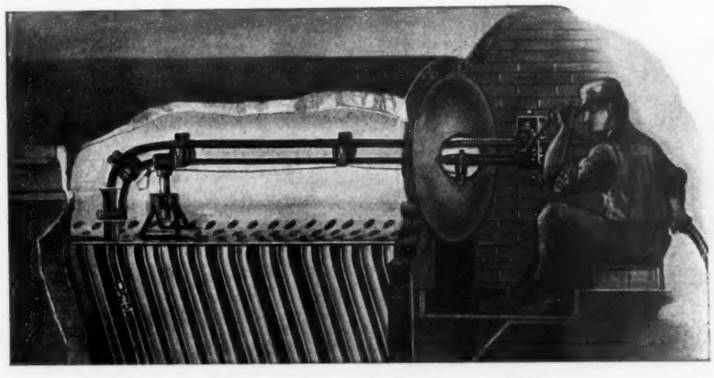
The device illustrated below has been designed for eliminating the necessity for workmen entering a boiler when cleaning the tubes. The mechanism consists of a funnel through which the cleaner is guided into the tube, a stand and shafting to support this funnel and the hose and to provide adjustment over the different tubes. The shafting is jointed and snapped together with triggers so that the sections can easily be handled and used in the limited space between boilers. On each section of shaft is a spool and rack on which the hose is rolled. The shafting is held in the center of the manhole by a tripod rigidly braced from the edge of the manhole. Extending from this tripod is the feeding device proper for feeding the hose into the tube. This feeding device consists of two capstan-shaped rolls which enclose and grip the hose and which are geared together, so that when one is turned by the crank the other turns. There is provision for squeezing these onto the hose as tightly as may be desired and the "capstan rolls" are lagged with leather which grips the hose.

The feeding device here shown has been placed on the market by the Lagonda Manufacturing Company, Springfield, Ohio.

Motor-Driven Coffee Grinders.

The use of electric motors to drive coffee mills is growing rapidly because of the perfect satisfaction given by the motors and the time and annoyance saved by having a machine to grind the coffee instead of being compelled to do the work by hand. Progressive grocers everywhere appreciate the advantage of having a clerk spend his time waiting on a customer and not turning a handwheel, because it pleases the customer to be waited on promptly.

The coffee mill illustrated is manufactured by B. C. Holwick, of Canton, Ohio, and is equipped with a single-phase Westinghouse motor. The outfit is an excellent combination of strength, durability, neatness and service. The grinders are milled from steel plates, which gives them true and sharp cutting edges, causing them to cut the coffee instead of crushing it. Steel-cut coffee is far more uniform in size than crushed coffee and is free from dust, and for these reasons gives a better flavor. The mills are provided with a certain adjustment by which it is possible to change from coarse to fine grinding or the reverse while running. Two pounds of coffee per minute may be granulated at a cost of one-thirtieth of a cent a pound. A durable self-cleaning attachment is provided by the manufacturers of this machine.



FEEDING DEVICE FOR BOILER-TUBE CLEANER.

COFFEE GRINDER.

Several of these mills on the circuits of a central station add to the revenues without increasing the peak load. Progressive managers who are endeavoring to increase the sale of electrical energy among merchants say they find the motor-driven coffee mill one of the easiest propositions in which to interest the grocer.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.

Reports of trade during the past week were irregular. It is undeniable that in most directions very much less is being done than had been anticipated. In fact, it would hardly be improper to say that in places there is a note of absolute discouragement. The revival of business, which was expected to occur early in the year has not materialized, and individual reports from manufacturing companies, especially in electrical and machinery lines, indicate that just at the present moment orders are scarcer than they have been at any time within the past six months. The agitation of the tariff is held responsible to a large degree to this condition of affairs. There is no doubt that there is widespread conservatism being practised in very branch of retail trade and even among individual consumers. In the leading wholesale markets of the country there are quite a number of visiting buyers, and this has given some activity to dry goods, cottons and notions. The buying, however, is hardly what might be called free. There are some millinery goods and some of the cheaper grade of cotton goods being taken. Heavy orders, however, do not seem to be in evidence. During the past week there was noted improvement in farm machinery, implements, seeds and fertilizers. This was simply the seasonable demand which is to be expected at the beginning of the crop year. Collections, especially in the South, are inclined to be slow, although there has been little complaint from the wheat growing section. Cereals for the moment are higher, wheat having been advanced in Chicago to an unusual figure. The export trade, however, is small and the demand at home is the only reason for this stiffening of prices. Reports from the growing crops are negative. The ground through most of the Northwest has been recently covered with snow, and this is generally taken to be favorable to crop conditions. It, however, leaves in doubt the actual condition of winter wheat. Until the spring thaws come, it will be impossible to tell exactly how the crop that was planted last fall has weathered the winter season. The sudden throwing down of the bars by the United States Steel Corporation, in its announced abandonment of the price agreement, is expected, in a mild degree, to demoralize the steel industry. It is also expected to bring in a number of orders which have been held up a long time waiting for cheaper prices. The long-continued dullness in the metal market and the lack of business in finished steel product made such a breakdown in the price agreement almost inevitable. So far there has been no change in the price of steel rails, although there are constant rumors that any road desiring a large quantity might very easily have the rate of $28 per ton considerably shaded. It is reported that within the past week the New York Central has allotted an order for 85,000 tons of rails and that smaller roads have ordered 20,000 tons in addition. These orders were distributed among the smaller plants. The Pennsylvania Railroad has placed an order for 2,404 steel gondola cars. It is reported that extra low prices were secured for this business. The building industry is not moving forward very rapidly and very few large projects are being discussed. This is one reason for the extra quiet condition of structural material. It is hardly believed that there will be much improvement until later in the spring. By this time we will probably know what the tariff schedules will be. Business failures for the week which ended Feb. 18 were 282 against 211 the previous week, 326 in 1908, 177 in 1907, 186 in 1906 and 220 in 1905.

THE COPPER MARKET.

The copper market was practically in a state of collapse during the week which ended Feb. 20. The long strain of attempting to sustain prices in the face of evident accumulation and of very limited buying has finally proved to be too great, even for the great interests which have been behind the market. The Metal Exchange, the quoted prices of which have been notoriously above the actual selling prices in the market, has practically admitted the defeat of the effort to keep up appearances. Prices were marked down last week not in the customary ⅛ fraction of a cent, but in a ⅜ drop. The result was that at the close of the week the official quoted price of copper was 13 cents for lake, 12¾ for electrolytic and 12⅝ for castings. This is a decrease within the week of about ⅝ of a cent. It is said that offerings are made on the Street even at cheaper rates, but these things are so hard to substantiate it is unsafe to attempt to quote such prices. The best information that can be obtained is that even this radical marking down of copper has developed but little buying. The principal consumers are running their plants at not more than 60 per cent of capacity hence the demand for copper is necessarily light. In some quarters it is believed that the consumers are fairly well supplied for all their immediate needs, but whether this is true or not it is certain that they are not buying for any purpose except to fill orders already taken. In the meantime the production continues to be the largest in the history of the country, imports are above the average and exports are running very much lighter than they were the same time last year. This latter is true, of course, because Europe is well stocked with metal and there is the same stagnation in the copper consuming industries abroad as exists here. One of the most careful statisticians in the copper market estimates that there is now held at home and abroad between 450,000,000 lb. and 500,000,000 lb. of "marketable" copper. This means that there is in sight at least nine months' supply for all the ordinary takings of the consumers. With the mines producing 110,000,000 lb. a month, the reduction of such a stock as this, if it really exists, must necessarily be very slow. The present depression in the price of copper and the undoubted pressure to sell indicates that these figures have finally been accepted by both buyers and sellers. What the outcome of such a condition can be, unless an arrangement can be made to curtail prediction, it is hard to say. Copper prices cannot go very much lower and leave a margin of profit for the majority of the large copper mining corporations. Production will certainly be curtailed when this margin has been wiped out. The exports so far for the month of February have been but 7,419 tons, which would seem to indicate that the total exports for the month would be below 30,000,000 lb. The exports for last February were over 55,000,000 lb. Quotations on the Metal Exchange Feb. 20 were:

Lake	13 @ 13¼
Electrolytic	12¾ @ 12⅞
Casting	12⅝ @ 12¾

London quotations were as follows:

	Noon. £ s d	Close. £ s d
Standard copper, spot	56 17 6	57 0 0
Standard copper, futures	57 15 0	57 16 3
Market	Weak.	Steady.
Sales of spot		400 tons
Sales of futures		2,400 tons

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	....	....
Lake	14.55	13.12½
Electrolytic	14.25	12.82½
Casting	14.12½	12.75
London, spot	£64 2 6	£56 17 6
London, futures	64 17 6	57 15 0
London, best selected	67 15 0	60 15 0

OLD-TIME WESTERN ELECTRIC EMPLOYEES.—During the recent gathering in Chicago of the sales organization of the Western Electric Company, there was a luncheon of old-timers, which brought together quite a number of the pioneer days of telephony. Many interesting reminiscences were told and many old friendshipe renewed. Those who attended the luncheon and the dates they entered the employ of the company were: E. W. Bennett, 1874; J. C. Cannon, 1877; F. B. Uhrig, now Western district supervisor of the company located at Kansas City, 1881; D. L. Harmon, now a banker at Indiana Harbor, Ind., 1883; C. D. Wilkinson, manager of the Minneapolis house, 1886; William Carpenter, of the Walworth & Neville Manufacturing Company, who entered the employ of the Western Electric Company in 1887; R. C. Hearsley, 1888, and E. S. Holmes, now manager of the Indianapolis house, 1890.

STEEL MAKERS FORCED TO CUT PRICES.—After valorously maintaining prices on iron and steel products during the dark days of depression, for the past 16 months, the United States Steel Corporation has finally been forced to surrender to the stress of the times. In a carefully prepared statement, made public Feb. 19, Judge Elbert H. Gary, chairman of the board of directors of the Steel Corporation and directing spirit in the steel business, announces the abandonment of the principle of price maintenance. No definite cuts in price are promulgated, but the price agreement is definitely abandoned and the door is thrown open for every steel maker to get the best prices he can. Even before Judge Gary's announcement had been formally made active price cutting had begun. Reductions of from $3 to $7 per ton were made by individual plants, and the scramble for business among the concerns, both inside and outside the big trust, was exceedingly active. There has been no reduction made as yet on steel rails—$28 per ton being still the prevailing price—but in almost every other product there has been liberal price shading. Steel bars have been offered $4 below schedule price, structural steel is down $7 a ton, sheets were off and even wire, which has been the best seller of all the steel products, was offered at lower prices where any considerable contract could be booked. In his statement, Judge Gary declares that following the panic of October, 1907, a rigid maintenance of prices was made necessary in order to protect from disaster jobbers and consumers who had purchased large stocks at prices which prevailed when conditions were favorable. These contracts having been protected, and there being little new business now coming to light, it is now deemed advisable to let every steel maker get all the business he can at the best price he can. Judge Gary, however, makes it plain that the abandonment of the price agreement was practically forced by the small concerns and that it was brought about suddenly. The statement says: "Until within the last 48 hours it has been the belief of many, if not most, of the leading manufacturers of iron and steel that no general reductions in prices were necessary or desirable. However, during the last two days many of the manufacturers have been in conference for the purpose of giving to one another all the information and facts obtainable concerning actual conditions in detail. It appears that for one reason or another, including particularly the tariff agitation, many of the smaller concerns who have not been disposed to co-operate during the last year have become more or less excited and demoralized, and have been selling their products at prices below those which were generally maintained. This feeling has been somewhat extended and has influenced unreasonable cutting of prices by some of those who were opposed to changes, but felt compelled to meet conditions in order to protect their customers. As a result of these conditions there has been a material decrease in new business during the last month for the reason, as stated by consumers, that they proposed to wait until after they were satisfied bottom prices has been reached." Speaking of the actual business done, Judge Gary says that during the month of December the average daily bookings of the subsidiary companies of the Steel Corporation were 29,685 tons. The total capacity of these plants is 36,000 tons, so that they were operated during this month at about 82.5 per cent of their full ability.

DUTY ON MICA PRONOUNCED EXCESSIVE.—The duty on mica which is now under consideration by the Ways and Means Committee of the House, together with other tariff duties, is creating a great deal of interest among the mica dealers. One of the principal mica importers and producers in this country has this to say: "The present rate of duty, which is 6 cents per lb. and 20 per cent ad valorem, is excessive. An examination of the mica statistics will show that within recent years the amount of duty paid on imported mica was more than the entire value of the domestic production. In 1906 there was produced $252,248 domestic mica. Duties on imported mica for that year were $291,033. In 1907 the domestic production was $349,311. In that same year there was paid $466,028 in duty. These figures are quoted simply to show how much more important is the importation of mica than the domestic production. The labor employed in mica mining in the United States is exceedingly small; at no time more than 1000, and at the present time probably not over 500. The interests asking for an increase in the already excessive duty are the few owners of mica mines which can only be operated at a profit when prices obtained for the output are most exorbitant when compared with prices obtained abroad. It would seem that the small contingent of American mica mine owners was excessively protected under the present tariff, but these interests are now asking for a further duty of double the present rate on white mica. In other words, when the duty paid in 1907 exceeded the entire production in the United States by over $100,000, these interests are still unsatisfied and are asking for an increase that would double the present already disproportionate relation between duty paid and domestic production. Even were the efforts to increase the duty entirely successful, it would be impossible for the domestic production to replace the imported in certain usages that consume the major portions of mica, such as insulation between copper bars, etc., for the reason that domestic mica has been found entirely too hard and brittle and contains too great a quantity of iron for this purpose. The unsuitability of domestic mica in general for electrical purposes is shown by the fact that during 1905, 1906 and 1907, the years of greatest consumption and highest prices, the production of mica in the United States increased but slightly, while on the other hand, the increase in importations was 300 per cent."

CONTINUING THE PRODUCER GAS TESTS.—The United States Geological Survey has purchased a 140-hp Westinghouse, three-cylinder, vertical, single-action gas engine, with which to continue the series of tests of producer gas made from various grades of bituminous coal, which were begun at the St. Louis Exposition. This engine is of the same type as the one used at the exposition. The use of the gas engine is rapidly broadening. One important application of this engine has just been made by the Mohican Oil & Gas Company, of Ohio, a large distributor of natural gas, for service as a compressor or booster to regulate the distribution of gas over long stretches of pipe line. The initial installation which was put in at Howard, Ohio, consists of two 1000-hp, direct-acting, two-stage compressors driven by Westinghouse horizontal, double-acting, twin-tandem gas engines. These units are designed to deliver into the pipes any desired pressure up to 300 lb. per square inch. Other installations of this character have been made in both Ohio and Kansas. The engines use natural gas. Another use for the gas engine is in connection with mining operations. The Capuzaya Mining Company, of Parral, Mex., has recently installed a 300-hp Westinghouse gas engine unit, which is operating on gas generated from charcoal.

WORCESTER (MASS.) ELECTRICAL EXPOSITION.—The management of the Worcester Mechanical and Electrical Exposition, which is to be held in Worcester, Mass., from March 27 to April 3, is arranging a number of novel exhibits to attract the attention of the business men to the practicability of modern electrical devices for cheapening of the products of large corporations. For the public at large the thousand and one machines and inventions for the use of the home will be given practical demonstration by the construction of an electrical house, every room of which will be completely furnished with the latest devices for cooking, eating, lighting, etc. In the mechanical end of the exposition will be seen heavier electric machines used for various purposes, magnetic chucks, etc. One of the scientific institutions is to put in a large electrical display of delicate instruments. This exposition is more than a local affair, and has as sponsors the Worcester County Mechanics' Association, which is composed of over 1300 business men of Massachusetts. Nearly every member of the association is an officer of some large corporation. Spaces at the exposition are already well taken and its success is assured. Full information regarding this exposition can be had of H. F. Campbell, Mechanics Hall, Worcester, Mass.

THE AMERICAN BLOWER COMPANY, Detroit, Mich., has shipped seven 2.5-kw engine-generator sets to the Isthmian Canal Commission, Colon, Isthmus of Panama. The engines were arranged to comply with the requirements, which stated that they should be "built for high speed, self-oiling, and automatically governed, and be able to control and also be strong enough to withstand a change from no-load to full-load, and should be of sufficient capacity to drive the 2.5-kw generator at the proper speed when under full-load and with initial pressure of 80 lb. per square inch," etc. Each engine is equipped with a small pump, which delivers oil to each moving part. The generators are 110-volt machines, built by the Fort Wayne Electric Works, Fort Wayne, Ind.

WIRE BUSINESS SHOWS LITTLE IMPROVEMENT.—The dealers in wire for electrical purposes are practically unanimous in saying that the business is showing but little improvement. There are many projects, hydro-electric and steam, that are under contemplation, but in almost every case they are being held up until general business further improves. A representative of a large manufacturer of bare copper wire is responsible for the statement that business is hardly more than 60 per cent of normal. There is not much new business coming in and some old contracts that were made last fall are being held up. In connection with insulated wire the manager of one important company had this to say: "We are constantly hoping for business to get better, but, as a matter of fact, it is showing little improvement. Our main business, of course, is on the inside of new buildings. Now the building business, as you know, has not been very extensive during the past few months so there are not many contracts of importance coming to light. Then again, wiring a building is one of the last things done so that in many instances even those buildings which have been started are not yet ready for us. If there should be a boom in building the coming spring it would probably be midsummer before we would get to our end of the contract. We are constantly hearing of projects that are on foot, but they are slow coming to realization."

EMPIRE STATE GAS AND ELECTRIC ASSOCIATION.—The headquarters of the Empire State Gas and Electric Association has been removed from 154 Nassau Street to the United Engineering Societies Building, 29 West Thirty-ninth Street, New York City. The following is the list of the officers and members of the executive committee for the year ending Oct. 31, 1909: President, William T. Morris, Ithaca; first vice-president, M. J. Brayton, Utica; second vice-president, R. M. Searle, Rochester; secretary, Charles H. B. Chapin, 29 West Thirty-ninth Street; treasurer, T. O. Horton, Staten Island; executive committee, Walter R. Addicks, Westchester Lighting Company; F. L. Dame, Geneva-Seneca Electric Company; G. W. Curran, Syracuse Lighting Company; J. J. Humphreys, Jr., Brooklyn Borough Gas Company; P. T. Glidden, Binghamton Light, Heat & Power Company.

CHICAGO PNEUMATIC TOOL COMPANY.—At the annual meeting of the Chicago Pneumatic Tool Company, last week, the president, J. W. Duntley, reported that the year 1908 had been a particularly severe one on the company on account of the general depression in business. The total net profits for the year were only $289,525, which is less than 35 per cent of what they were in the previous year. The balance available for dividends, on the year's business, after deducting the fixed charges, was only $129,575, or about 1.85 per cent on the capital stock. At the directors' meeting the resignation of President J. W. Duntley, who expressed his intention of retiring some weeks ago, was accepted, and his brother, W. O. Duntley, former vice-president, was elected to fill his place. Charles M. Schwab retired as chairman of the board, being succeeded by J. R. McGinley. Charles Booth was elected to the vice-presidency to succeed W. O. Duntley.

STREET TRANSPORTATION ON FIVE LEVELS.—The Public Service Commission of the First District of New York has written a letter to the Board of Estimates and Apportionment calling attention to the application of the Hudson & Manhattan Railroad Company for authority to extend its subway under Sixth Avenue to the Grand Central Station. The communication says that with the various plans which the Board of Estimate has now under consideration there would be transportation in some places in the city on five levels, and that the lowest would be 100 ft. below the surface of the street. The Commission suggests that very careful consideration be given to this phase of the rapid transit problem.

GIGANTIC ELECTRICAL DISPLAY ON NEW BRIDGE.—According to present plans, real estate interests connected with the development of the Borough of Queens, New York City, propose to erect on the south side of the new Queensboro, or Blackwell's Island, bridge, when it is opened for traffic, the most gigantic electrical display ever attempted. The entire face of the bridge will be covered with an electrical map of Long Island. The map will be about 3000 ft. long and will be 69 ft. high. The island will be outlined in red, the principal towns and cities in green and separate contrivances to show the leading transmission lines. There will be a number of other electrical displays at the opening session and they will be so arranged with switches as to show alternately.

ELECTRICAL EQUIPMENT FOR ITALY.—An American consul reports that the Palace of Justice in Rome is preparing to install an electric light plant and that the same department has advertised for the delivery of wire cables amounting to $40,000.

Financial Intelligence.

THE WEEK IN WALL STREET.

Of course there was nothing in the stock market during the past week that cut any figure in comparison with the breakdown in the combination on steel prices. After having made a valorous fight for 16 months to uphold prices in the face of adverse conditions, the United States Steel Corporation was finally forced to admit its defeat. There was no general cut in prices announced by the corporation, but simply a letting down of the bars whereby every manufacturer could come in and get business at the best rates at which he could afford to take it. The effect on the stock market was immediate. Even before the surrender had been announced there was fairly complete information that it was coming and the price of United States Steel common stock, which is dependent upon the excess earnings of the company for dividends, began to crumble. The preferred shares of the Steel Corporation are practically assured of their 7 per cent dividend by the high earning capacity of the organization. Producing this dividend and the fixed charges is, however, a considerable undertaking, and the dividends on the common stock must be dependent upon extra profit. The same powers that undertook to maintain the price of steel products, in the face of business depression, undertook to put steel common above 50 and hold it there. As soon as the price combine was broken the price of steel stock necessarily fell in sympathy. There are other conditions, however, in the steel situation which are interesting and important. In the first place the immediate effect of the cut has been to vastly stimulate orders for steel products. It is said that the Carnegie Steel Company made a record in its bookings on Feb. 20. This large influx of business means the continued operation of the steel plants, but whether or not it means a reduction in wages remains to be seen. It is intimated that orders cannot be filled at the present rates, upon the existing scale of wages. The weakness in steel shares sympathetically affected all of the balance of the list. The net changes for the week which ended Feb. 20 were in almost every instance losses ranging from 1 to 6 points. The volume of trade, however, was somewhat increased, and, while there was little more outside interest displayed, there was considerable more buying by the regular traders who have practically made the market since the first of January. In the bond market there was the same eagerness displayed to take every issue that offered a

NEW YORK.

	Feb. 15.	Feb. 20.	Shares sold.		Feb. 15.	Feb. 20.	Shares sold.
All.-Ch.	15¼	14¼	1,315	Int.-Met., pfd.	44¼	41	11,825
All.-Ch., pfd.	48⅞	45⅜	2,200	Mackay Cos.	72	72¼	1,455
Amal. Cop.	76⅞	49	164,310	Mackay Cos., pfd.	72*	71¼	700
Am. D. T.	35*	35*	——	Manhattan Elev.	148½*	145	16
Am. Loc.	57	51	23,600	Met. St. Ry.	30	30	200
Am. Loc., pfd.	112	112	875	N.Y. & N.J. Tel.	115	115	300
Am. Tel. & Cbl.	78	78*	——	Steel, com.	53⅛	46	633,320
Am. T. & T.	129⅜	128¼	12,200	Steel, pfd.	114⅛	109⅝	26,895
B. R. T.	72⅜	69⅞	99,015	W. U. T.	68	67¼	1,100
Gen. Elec.	158	152½	5,072	West'h., com.	83	79¾	4,700
Int.-Met., com.	16¼	15	10,150	West'h., pfd.	118*	118	400

PHILADELPHIA.

	Feb. 15.	Feb. 20.	Shares sold.		Feb. 15.	Feb. 20.	Shares sold.
Am. Rys.	40½	46½*	——	Phila. Elec.	12	11⅞	——
Elec. Co. of A.	11½	11½	——	Phila. R. T.	28¼	27⅛	——
Elec. Stor. B'ty.	46¼	46*	——	Phila. Traction.	93	92½*	——
E. S. B'ty, pfd.	49*	49*	——	Union Traction.	53¾	53	——

CHICAGO.

	Feb. 15.	Feb. 20.	Shares sold.		Feb. 15.	Feb. 20.	Shares sold.
Chi. City Ry.	187	187*	——	Chi. Tel. Co.	130⅜	131½	——
Chi. Rys., Ser. 1.	112½	112½*	——	Met. El., com.	17*	16*	——
Chi. Rys., Ser. 2.	44¼	44*	——	Nat'nal Carbon.	84	85½*	——
Com. Edison.	108	108½	——	Nat. Carb., pfd.	110*	118¾	——
Chi. Subways.	26*	26*	——				

BOSTON.

	Feb. 15.	Feb. 20.	Shares sold.		Feb. 15.	Feb. 20.	Shares sold.
Am. Tel. & Tel.	129¼	128¾	——	Mex. Tel.	2½	2⅛	——
Com. Tel.	125*	125*	——	Mex. Tel., pfd.	5½*	5½	——
Edison El. Ill.	251	—	——	N. E. Tel.	131	131½*	——
Gen. Elec.	157½	—	——	W. Tel. & Tel.	7¼	7*	——
Mass. Elec. Ry.	14¾	14½	——	W. T. & T., pfd.	79*	78*	——
Mass. E. R., pfd.	65¾*	65¼	——				

*Last price quoted.
Shares sold are for week Feb. 15 to Feb. 20.

good investment. No proposition seems too large for the present market to absorb. The talk of an issue of more than $80,000,000 by the Southern Pacific in nowise disturbs conditions and every one familiar with the market is practically certain that such an issue would be absorbed without trouble. As an instance of the strength of bonds it is but necessary to point out that the $15,000,000 issue of the Burlington was subscribed 10 times over. In other words, there was $150,000,000 ready to take bonds. The actual money market was not quite so easy during the past week as it has been for several months. While there was no apparent scarcity and while rates were only slightly advanced there was in evidence less urgency to lend money. The banks and trust companies seemed to be willing to hold off until the industrial and commercial conditions had settled down from the temporary disturbance caused by the cut in steel prices. Nominal quotations for money on Feb. 20 were call loans 2 per cent and 90-day paper 2¾ @ 3 per cent. The quotations in the table are those of the close Feb. 20.

KINGS COUNTY ELECTRIC COMPANY SHOWS INCREASED EARNINGS.—The annual report of the Kings County Electric Light & Power Company, of Brooklyn, N. Y., shows that in spite of the depressed condition of general business the increase in the company's earnings has been very satisfactory. The gross earnings of the company were $3,613,470, an increase of $141,729 over 1907, while the operating expenses showed a decline of $38,637. By this system of economy the net earnings are made to show an increase of $180,367. The surplus for the year, after dividends, was $29,513. This, added to the previous surplus, makes the total surplus carried by the company $1,207,574. The annual stockholders' meeting has not yet been held, but it is not anticipated that there will be any change in the board of directors or in the management of the company. The entire capital stock of the Edison Electric Illuminating Company of Brooklyn is owned by the Kings County company and there is no separate report made of that company.

INTERSTATE RAILWAYS REORGANIZATION PLAN.—Mr. J. J. Sullivan, president of the American Railways Company, Philadelphia, has issued notices to the holders of the collateral trust 4 per cent bonds of the Interstate Railways Company, which are now in default, offering to purchase the bonds at 50 per cent of their par value, giving in exchange the 50-year 4½ per cent convertible gold bonds of the American Railways Company. In order to carry out this plan the directors of the American Railways Company have authorized a new issue of $6,000,000 4½ per cent bonds, of which $5,390,625 will be required to retire the $10,781,250 Interstate issue. The proposed plan is being generally accepted by the holders of the defaulted bonds. The new issue of the American company bears interest from Jan. 1, 1910, and is convertible into the stock of the company at any time between Jan. 1, 1911, and Jan. 1, 1915. The American Railways Company has enough unissued stock already authorized to meet the conversion.

TOLEDO RAILWAYS & LIGHT COMPANY.—The Toledo Railways & Light Company for the year 1908 shows earnings which amount to 2.26 per cent on its capital stock. The gross earnings of the company were $2,542,111, which is a decrease of $23,089 in comparison with the previous year. The net earnings, however, were the largest in the history of the company, owing to the creditable reduction made in the operating expenses. The net surplus for the year was $313,307. In spite of the fact that the company has not been in the best of financial condition the work of construction and extension has not been neglected. During the past year a transformer substation of 2000-kw capacity, a rotary converter of 400-kw capacity and a section lighting substation have been added to the equipment.

INCREASE IN TRACTION OPERATING COSTS.—The annual report made by the Northamptom Street Railway Company to the Massachusetts Railway Commission is interesting in showing how much more it costs to operate a traction line than it did a few years ago. The report shows that wages, coal and supplies cost the company 33 per cent more than they did 10 years ago. The total cost of carrying a passenger, including taxes and interest, has advanced from 4.41 cents to 4.59 cents. Within the past 13 years the company's income per car mile has increased less than 2 per cent, while the operating cost per car mile has advanced 45 per cent.

LONDON UNDERGROUND EARNINGS INCREASE.—The financial reports of the London Underground System and the Metropolitan District Railway for the six months which ended Dec. 31, 1908, show substantial gains in earnings while for the most part there has been a decrease in the operating expenses. The Baker Street & Waterloo division has increased £17,106; the Great Northern, Piccadilly & Brompton division, £23,963; the Charing Cross, Euston & Hampstead division, £19,738, and the Metropolitan District Railway increased £37,411. The average increase in the number of passengers carried was about 25 per cent.

MEXICAN LIGHT & POWER COMPANY TAKEN OVER.—In spite of the opposition raised by interests identified with the Bank of Montreal, the Mexican Tramways Company has finally taken control of the Mexican light & Power Company, the old management has been turned out and a new board of directors headed by Dr. F. S. Pearson, of New York, has been placed in charge. The new interests state that they intend to operate the property in the interests of the minority shareholders just as much as of the majority. The capacity of the plants will be considerably increased.

NEW HUDSON & MANHATTAN BONDS.—The Hudson & Manhattan Railroad Company has just issued, through the Guaranty Trust Company of New York, $920,000 5 per cent car trust bonds. These bonds are secured by a mortgage upon $1,143,180 of new car equipment, the company paying in cash a trifle more than 20 per cent of the purchase price. The equipment offered as security consists of 90 steel motor cars which cost $12,700 each. They will be put into service in the Jersey City tubes when these are opened in July. The bonds were placed on a basis of about 6 per cent.

BOSTON CONSOLIDATED COPPER COMPANY INCREASES STOCK.—At the annual meeting of the Boston Consolidated Copper Mining Company, which was held in London Feb. 19, the shareholders were asked to authorize an issue of 50,000 shares of new stock to be offered at £2.55, or about $11.25 per share. This issue makes the total outstanding stock issue of the company 775,000 shares. The new stock has been underwritten by a joint syndicate, one-half being taken in this country and one-half abroad.

BELL TELEPHONE INTERESTS LOSE.—The Supreme Court of Illinois has finally rendered a decision denying the right of the American Telephone & Telegraph Company to acquire the majority stock of the Kellogg Switchboard Company. This suit has been in the courts for eight years and was brought by the minority stockholders. The basis of the decision is that it is against public policy to permit a foreign corporation to procure control of an Illinois corporation for the purpose of creating a monopoly.

CHESAPEAKE & POTOMAC TELEPHONE COMPANY.—The annual report of the Chesapeake & Potomac Telephone Company, Washington, D. C., for 1908 shows total receipts of $1,180,384 and total expenditures of $1,056,723, which left a revenue balance of $123,661. Receipts from sale of notes and stock amounted to $1,400,865; total expenditures on account of capital included real estate, $733,437; conduits and cables, $372,664; aerial wires, $37,068, and equipment, $256,695, a total of $1,400,865.

NEW SECRETARY FOR WESTINGHOUSE COMPANY.—At a recent meeting of the directors of the Westinghouse Electric & Manufacturing Company Mr. W. A. Esselstyn was chosen secretary to succeed Mr. Charles A. Terry, who was recently elected vice-president. Mr. Esselstyn has been connected with Westinghouse enterprises for more than 20 years, having been chiefly identified with the auditing and treasury departments. During the receivership he acted as secretary.

UNION NATURAL GAS CORPORATION, COLUMBUS, OHIO.—The report for 1908 of the Union Natural Gas Corporation, of Columbus, Ohio, shows that the company during the year has required 32,015 acres of new oil and gas leases. The net earnings for the year were $1,904,721, and the balance after paying fixed charges and 10 per cent dividends on the capital stock was $754,015.

UNION SWITCH & SIGNAL COMPANY.—The annual report of the Union Switch & Signal Company for 1908, shows that the total income of the company was $2,123,542 as compared with $5,023,599 in 1907. The surplus for the year was only $77,848 as compared with $799,598 for the previous year. The annual meeting of the company will be held March 9.

CHICAGO CONSOLIDATION ABANDONED.—It is authoritatively announced in Chicago that the negotiations tending toward the consolidation of the Chicago City Railway, the Chicago Railways and the Commonwealth Edison Company have been temporarily abandoned. Dissentions have arisen as to the valuations of the two traction companies. It is said that the Railways company interests consider that the valuation placed by the City Railway owners upon their property is entirely too high and that the figures will not be accepted as a basis of negotiations. The trouble reverts back to the time when the Morgan-Mitchell paid $200 per share for the South Side Traction Company's stock on the belief that its 99-year franchise was valid. This franchise having been knocked out by the United States Supreme Court the syndicate has had a hard time trying to get out anywhere near even.

LAKE SUPERIOR COPPER CONSOLIDATION.—The reported deal between the Calumet & Hecla interests and the mining interests represented by the Bigelow-Hyams syndicate, has not been officially confirmed as yet, but is generally accepted as a fact. This is practically a consolidation of control as the ownership interests are already largely identical. It is given out that the amount involved in the deal is a little more than $8,000,000, but if all of the Bigelow properties outside the Calumet & Hecla are involved the amount represented is at least three times this sum. The total output of the combined properties when operated at full capacity is expected to be at least 150,000,000 lb. per year.

OHIO TELEPHONE COMPANY SOLD.—The National Telephone Company, of Wheeling, W. Va., which is known as one of the largest independent companies in the West, has purchased, for $540,000, the Woodsville Telephone Company, operating in Monroe County, Ohio. The new owners of the plant will commence its improvements at once, and set about the extension of its lines.

REPORTS OF EARNINGS.

	Gross Earnings.	Expenses.	Net Earnings.	Charges.	Surplus.
American Telephone & Telegraph Company:					
January, 1909	$4,101,906	$180,674	$3,921,232	$774,010	$3,147,222
January, 1908	3,790,498	160,282	3,630,216	633,394	2,996,822
Birmingham (Ala.) Railway, Light & Power Company:					
January, 1909	192,343	119,635	72,707	44,783	27,924
January, 1908	177,745	125,802	51,942	43,789	8,162
Brockton & Plymouth (Mass.) Street Railway Company:					
Year, 1908	122,265	88,440	33,825	26,754	7,070
Year, 1907	119,365	82,106	37,259	26,977	10,281
Cape Breton (N. S.) Electric Company:					
Year, 1908	247,545	142,509	105,036	48,511	56,524
Year, 1907	250,064	152,625	97,438	47,284	50,154
Dominion Power & Transmission Company, Hamilton, Can.:					
Year, 1908	1,600,312	974,641	625,671	323,047	302,623
Edison Electric Illuminating Company, Brockton, Mass.:					
Year, 1908	218,927	117,283	101,644	29,213	72,431
Year, 1907	197,966	109,036	88,930	14,336	74,593
Electric Light & Power Company, Abington, Mass.:					
Year, 1908	58,811	34,445	24,366	3,824	20,541
Year, 1907	53,200	31,599	21,601	4,996	16,604
El Paso (Tex.) Electric Companies:					
Year, 1908	534,223	384,639	149,584	86,893	62,690
Year, 1907	506,694	370,120	136,574	68,845	67,728
Fall River (Mass.) Gas Works:					
Year, 1908	407,967	237,776	170,191	28,661	141,529
Year, 1907	396,634	232,338	164,296	26,354	137,942
Galveston-Houston (Tex.) Electric Company:					
Year, 1908	1,088,447	627,972	460,474	213,666	246,808
Year, 1907	1,050,892	616,946	433,946	193,276	240,669
Houghton County (Mich.) Electric Light Company:					
Year, 1908	246,400	120,328	126,072	39,988	80,869
Year, 1907	249,066	122,250	126,815	34,184	92,631
Houghton County (Mich.) Traction Company:					
Year, 1908	265,575	148,244	117,330	59,632	57,698
Year, 1907	249,919	146,317	103,601	57,049	46,552
Hudson River Telephone Company, Albany, N. Y.:					
Year, 1908	1,464,209	1,033,278	430,931	311,980	118,951
Year, 1907	1,474,308	1,103,783	370,525	255,402	115,123
Jacksonville (Fla.) Electric Company:					
Year, 1908	430,837	253,943	176,894	98,909	77,985
Year, 1907	392,393	231,191	161,202	75,315	85,887
Kings County (N. Y.) Electric Light & Power Company:					
Year, 1908	3,613,470	1,747,757	1,865,712	606,560	829,513
Year, 1907	3,471,740	1,786,395	1,685,345	606,560	785,853
Knoxville Railway & Light Company:					
January, 1909	48,217	24,668	23,549	11,483	12,065
January, 1908	38,505	26,785	11,720	11,447	272
Little Rock (Ark.) Railway & Electric Company:					
January, 1909	59,904	29,543	30,360	10,726	19,634
January, 1908	55,680	26,363	29,317	9,579	19,737
Lowell (Mass.) Electric Light Corporation:					
Year, 1908	340,679	196,822	143,857	44,366	99,491
Year, 1907	315,344	175,086	140,257	39,279	100,978
Pacific Telephone & Telegraph Company, San Francisco:					
Year, 1908	10,699,650	8,924,179	1,775,471	1,080,000	695,471
Year, 1907	9,223,564	7,828,416	1,395,148	1,080,000	315,108
Paducah (Ky.) Traction & Light Company:					
Year, 1908	226,613	133,393	93,220	81,349	11,870
Year, 1907	237,513	152,890	84,622	80,773	5,849
Pensacola (Fla.) Electric Company:					
Year, 1908	209,182	144,870	64,311	51,161	13,150
Year, 1907	228,149	145,656	82,493	47,128	35,364
Puget Sound Electric Railway & Subsidiary Company, Tacoma, Wash.:					
Year, 1908	1,694,973	1,096,747	598,226	468,445	48,694
Year, 1907	1,664,281	1,027,894	636,387	408,761	43,031
Rochester (N. Y.) Railway Company:					
Quarter ended Sept. 30, 1908	732,512	462,767	270,846	.....	.....
Quarter ended Sept. 30, 1907	740,770	464,546	276,224	.....	.....
Savannah (Ga.) Electric Company:					
Year, 1908	595,819	388,829	206,989	186,614	20,374
Year, 1907	602,399	383,717	218,682	174,626	44,056
Tampa (Fla.) Electric Company:					
Year, 1908	552,574	367,909	184,664	36,024	148,640
Year, 1907	521,181	376,639	144,341	18,021	126,520
Union Switch & Signal Company, Pittsburgh:					
Year, 1908	2,123,542	2,045,694	77,848	.....	.....
Year, 1907	5,023,598	2,998,756	1,024,842	.....	.....
United Railways, St Louis:					
January, 1909	829,036	544,752	284,284	235,568	48,716
January, 1908	827,398	554,359	273,039	233,454	39,585
West Penn Railways Company, Pittsburgh:					
Year, 1908	1,551,138	859,264	691,874	446,306	245,568
Year, 1907	1,603,100	841,767	761,333	416,734	344,599
Whatcom County Railway & Light Company, Bellingham, Wash.:					
Year, 1908	362,251	206,758	155,493	99,691	55,801
Year, 1907	354,469	199,375	155,094	88,583	66,510
Wilkes-Parre Gas & Electric Company:					
Year 1908	396,301	206,789	189,512	118,678	70,833
Year, 1907	361,349	194,672	166,677	111,789	54,887

GENERAL NEWS

Construction News.

DEMOPOLIS, ALA.—The Demopolis Telephone Company is making arrangements to construct a telephone line to Galion, Prairieville, Allenville and Lanesville.

GLOBE, ARIZ.—The Globe Electric Light & Gas Company is making arrangements to enlarge its plant. The company is also planning to extend its gas mains.

HEBER, ARK.—John M. Covey, of Earle, Ark., has been granted a franchise to install an electric light plant in Heber.

LOS ANGELES, CAL.—The flooding of the Kern River has put the large hydro-electric power plant of the Edison Electric Company at Bakersfield, Cal., out of commission. The tunnel at Lucas Creek, several miles above the plant, has been damaged for a distance of 500 ft. The plant furnishes electricity to operate the system in Los Angeles and Southern California. Energy will be supplied from the local steam plant until repairs are made.

OROVILLE, CAL.—It is stated that work of enlarging the electric plant of the Great Western Power Company at Big Bend, near Oroville, will commence as soon as the weather will permit. The output of the plant will be increased to 144,000 hp. Work will also commence on the construction of the large dam at Big Meadows. The above work will involve an expenditure of about $5,000,000. H. P. Wilson is secretary.

PASADENA, CAL.—The citizens on Feb. 11 voted in favor of the proposition to issue $150,000 in bonds, the proceeds to be used to complete the municipal electric light plant. C. W. Koiner is manager.

PASADENA, CAL.—The Edison Electric Company, of Los Angeles, it is said, is cutting its rates for electricity to keep its patrons from taking electrical service from the municipal electric plant. The company has placed orders for additional generators to be installed immediately to increase the output of its plant.

PASO ROBLES, CAL.—The Council has decided to appoint a committee of five, with power to employ experts to be paid by the city, to make investigations and estimates as to the cost of establishing an electric light plant and water works system for the city.

REDLANDS, CAL.—It is reported that the Domestic Water Company is planning to erect a transformer station at the corner of Reservoir and Crescent Avenues.

VALLEJO, CAL.—The contract for the installation of electric freight elevator in storehouse at Mare Island navy yard has been awarded to the Otis Elevator Company, of New York, N. Y., for which an appropriation of $4,000 was made.

SAYBROOK, CONN.—The Shore Line Electric Railway Company filed a petition with the State Board of Railroad Commissioners asking for approval of its proposed route in the towns of Old Saybrook, Essex and Westbrook.

WASHINGTON, D. C.—The Capital City Telephone Company is planning to make extensive improvements in its system in Washington and surrounding territory.

ATLANTA, GA.—The electric light committee of the Council is considering the question of disposing of the electric plant formerly owned by the Town of Edgewater before it was annexed to Atlanta. The Georgia Railway & Electric Company has made a bid for the distributing system, which will not be needed at the water works, with provision that it will resell it to the city in case it might be needed, which leaves only the generating equipment, lamps, pumps and meters to be disposed of.

AUGUSTA, GA.—Judge R. R. Lamar has been appointed to present the claim of the Twin City Power Company before the War Department at Washington, D. C., for permission to begin work on the proposed water power development at Price's Island, on the Savannah River, near Modoc. The Ambursen Hydraulic Construction Company has the contract for construction of the dam.

FORSYTH, GA.—The Upson Manufacturing Company has decided to remove its plant from Waymanville to Forsyth. The factory will have 3000 spindles, which will be operated by steam power at first, but it is expected that it will be superseded by electricity later. The name of the company has been changed to the Newton-Harp Manufacturing Company. W. H. Newton is general manager.

HAWKINSVILLE, GA.—W. O. Jelks, of Hawkinsville, and G. E. Clower, of Auburn, both connected with the University of Alabama, have been engaged to prepare plans and specifications for a municipal electric light plant, for which $15,000 has been appropriated. C. W. Harris is city clerk.

WASHINGTON, GA.—A company is being formed with a capital stock of $65,000 to take over the property of the Pope Manufacturing Company. The new company proposes to enlarge the electric light plant to furnish electricity for a day service for commercial purposes.

SHELLEY, IDAHO.—It is stated that a company recently organized will install a power plant at Gem Falls, two miles distant, to cost about $100,000.

WALLACE, IDAHO.—We are informed that the Spokane, Wallace & Interstate Railway Company has completed its final surveys and has secured considerable right of way for its proposed electric railway between Wallace, Idaho, and Spokane, Wash., a distance of about 100 miles. It is planned to begin construction work this year, but as yet no contracts have been awarded. The overhead type of catenary construction will be used. Direct current will be transmitted at 1200 volts. No definite arrangements have yet been made for furnishing power for operating the system. The company expects to operate 24 passenger, 2 express motor and 118 freight cars, and also four 50-ton electric locomotives for freight service. F. F. Johnson, of Wallace, is president.

CORNELL, ILL.—The Cornell Telephone Company has decided to install a new switchboard in its exchange.

GALESBURG, ILL.—The Galesburg Union Telephone Company contemplates the construction of another telephone line direct to West Quincy, work on which will begin as soon as the weather permits.

GENEVA, ILL.—The City Council has granted a 50-year franchise to the Chicago, Wheaton & Western Electric Railway Company, for which it paid the city $30,000. The new road will be an extension of the third-rail system west of Wheaton, through West Chicago to Geneva, and probably to Sycamore. Henry C. Wood, of Wheaton, is president and attorney for the company.

CONNERSVILLE, IND.—Application has been made to the City Council by W. W. McFarlan for a franchise to install an electric light system in Connersville. A general franchise covering the entire city is asked, although the main object of establishing the plant is to furnish electricity for lamps for the McFarlan Hotel.

HUNTINGTON, IND.—The Majonica Telephone Company has made an assessment of $6 on each of its 700 stockholders to cover the cost of repairing the system damaged by the recent sleet storm.

INDIANAPOLIS, IND.—The Laycock Power House Company has filed notice of increase of capital from $100,000 to $150,000 for the purpose of increasing the output and improving its power plant.

INDIANAPOLIS, IND.—The Indianapolis & Western Railway Company, which, it is said, is planning to extend its railway from Danville to Amo, will also build an extension from Amo to Sullivan, a distance of 75 miles.

INDIANAPOLIS, IND.—A permit has been granted to the Rice Electrical Display Company, of Dayton, Ohio, to construct a steel framework on the roof of the Commercial Block, corner Washington and Illinois Streets and Kentucky Avenue, for an electric advertising display that will cost about $50,000. The display presents a large screen, and by the manipulation of 10,000 electric bulbs will appear to be in motion. Work will begin at once and be completed by June 1. One of the scenes to be displayed is the Hen-Hur chariot race.

JASONVILLE, IND.—The Town Council has granted a franchise to T. J. McGraw to construct and operate a telephone system in Jasonville.

LOGANSPORT, IND.—It is estimated that upward of $50,000 will be expended to repair the damages to telephone wires, poles and property in northern Indiana. Until poles can be erected, the wires are being strung on fences.

ORLAND, IND.—Robert N. Sanderson contemplates installing an electric plant in his mill and furnish electricity for lamps in this town. The village authorities have decided to install electric lamps on the streets.

THORNTOWN, IND.—Plans are now being made for the construction and equipment of a combined water, electric light and heating system in this city. A gift of $50,000 has been made to the town for the purpose of installing a water plant by General Mills, of Washington, D. C., and the city will appropriate sufficient to insure the combined system. Contracts for the work will be awarded soon.

WHITESTOWN, IND.—The Whitestown Citizens' Telephone Company has filed amendments to its charter increasing its capital stock from $1,800 to $20,625. J. Frank Laughnor is secretary and treasurer.

ANITA, IA.—We are informed that nothing definite as yet has been done toward the construction of an electric light plant. The city would like to grant a franchise to some company to install a plant. H. H. Cate is city clerk.

CLARION, IA.—Plans are being considered for installing a boiler and engine in the municipal electric light plant. O. P. Strickler is manager.

COUNCIL BLUFFS, IA.—It is reported that the contract for the construction of the section from Council Bluffs, Ia., to Traynor, 15 miles in length, of the proposed Iowa & Omaha Short Line Railway, has been awarded to George W. Adams & Company, of Walnut, Ia. J. H. Mayne, of Walnut, Ia., is chief engineer.

EARLHAM, IA.—Owing to the election held in June, at which it was voted to install an electric light plant and water works system, having been declared illegal, a special election was held Feb. 10 to vote again

on the proposition. The citizens again voted in favor of the project and the matter will now be hurried to completion. Preliminary steps have already been taken to install both systems.

OSSIAN, IA.—The Town Council contemplates holding an election to vote on the proposition to establish a municipal electric light plant in Ossian.

PITTSBURG, KAN.—The Joplin & Pittsburg Railway Company has been granted a 30-year franchise in this city. The company has also been granted a 99-year franchise in the town of Cherokee, Kan.

BRINKLEY, KY.—The Sassafrac-Ball Telephone Company, recently organized, proposes to construct telephone lines from Brinkley via Sassafrac and Ball to Quicksand, a distance of 18 miles. James Garnett, of Brinkley, is manager.

FOLSOMDALE, KY.—The Home Telephone Company has decided to install a new and larger switchboard in its local exchange.

HARLAN, KY.—The Harlan Telephone Company is planning to erect a telephone line from Harlan to Hagan, Va., a distance of about 20 miles. Material for construction of the line will soon be purchased. F. G. Green, of Harlan, is manager.

BANGOR, MAINE.—Plans are being considered by the Bangor Railway & Electric Company for replacing the wooden dam across the Penobscot River, which now furnishes power for its electric plant in Veazie, with a concrete structure during the coming summer at a cost from $75,000 to $100,000.

LEWISTON, MAINE.—A bill has been introduced in the Legislature incorporating the Androscoggin Railroad Company for the purpose of constructing a street railway in the towns of East Livermore, Livermore and Turner from the terminus of the Auburn & Turner Railroad in Turner to East Livermore. The capital stock is placed at $300,000, and the incorporators are: Hewitt M. Lowe, of Turner; John A. Jones, Albert M. Kavanaugh, of Lewiston; Harry Manser, of Auburn, and Frank W. Brigham, of Boston, Mass.

BALTIMORE, MD.—The Maryland Electric Railways Company has made application for a franchise in this city to connect with the Baltimore & Ohio Railroad and to enter the Camden station. John Wilson Brown is president and J. F. Heyward general manager, both of Baltimore.

DENTON, MD.—Thomas F. Garey, of Baltimore, Md., has filed his acceptance of the franchise granted by the Commissioners to furnish electricity in Denton, and will construct an electric light plant at his mill stream, near the town. It is planned to have the plant completed and in service in June. Mr. Garey also proposes to extend the transmission lines to Greensboro, Ridgeley, Queen Anne's and Hillboro to furnish electricity for lamps and motors.

MIDDLETON, MASS.—Matthew M. Merritt has applied to the Town of Middleton for a franchise to supply electricity to the town. Mr. Merritt, it is said, proposes to secure electricity for operating the system from the municipal plant at Danvers, if possible. If not he will erect a power station in Middleton.

PEABODY, MASS.—The Peabody Light Board has submitted its annual report to the Town Board, showing a cost of $1,418 for lighting the streets of the town with 188 arc lamps and 70 incandescent lamps. The committee recommends an increase in the equipment of the plant to meet the demands for commercial lighting, which the plant is at present unable to supply.

BATTLE CREEK, MICH.—The Battle Creek, Coldwater & Southern Railway Company is making arrangements to construct an electric railway from Battle Creek to Coldwater, Mich., and from there southward. The company has purchased 26 miles of steam railroad graded roadbed between the two cities. C. E. Flynn, of Erie, Pa., is president.

LAKE CITY, MICH.—The stockholders of the Missaukee Telephone Company have decided to increase the capital stock from $20,000 to $40,000.

MANKATO, MINN.—Bids will be received until Feb. 26 by the Board of Public Works for furnishing equipment for a sewage pumping plant, as follows: One 8-in. vertical submerged centrifugal pump, one 18-in. vertical submerged centrifugal pump, one 15-hp 3-phase motor, one 65-hp 3-phase motor. The motors may be of horizontal type, making belt connections with vertical pump shaft. Second-hand motors will be considered. Electricity will be furnished at 2300 volts, alternating current. Bids also to include the necessary transformers. The bids are to be itemized as follows: Motors, transformers, and pumps complete. All bids to be f. o. b. Mankato. The city will install the plant. J. N. Day is president of the Board of Public Works.

MINNEAPOLIS, MINN.—Senator T. T. Ewell, of Minneapolis, Minn., has introduced a bill in the State Legislature, authorizing cities with a population of 50,000 or more to exercise the power of eminent domain to acquire lighting and heating plants by condemnation if they so desire. The design of the bill is to furnish means by which lighting plants can be acquired by municipalities at a fair valuation.

VIRGINIA, MINN.—The Virginia Light & Water Company contemplates making improvements to its system during the coming year, which will involve an expenditure of about $75,000.

GRENADA, MISS.—The City Council is considering the question of issuing bonds to provide funds for improvements to the municipal electric light plant. The cost of the work is estimated at $35,000.

BENTONVILLE, MO.—Arrangements are being made by the Western Surety & Adjustable Company, of Minneapolis, Minn., to commence work on the construction of an electric interurban railway from Bentonville to Joplin. The company has established headquarters at Bentonville.

ST. LOUIS, MO.—The contract for lighting the downtown streets for a term of ten years, beginning Sept. 1, 1910, has been awarded by the Board of Public Service to the Union Electric Light & Power Company. Under the new contract the cost of arc lamps will be reduced from $98 to $55 per lamp per year, which will mean a saving to the city of more than $516,000 in ten years. The board has also approved the plan of the Downtown Lighting Association to install 470 artistic electroliers in the business district, now lighted by 136 arc lamps.

SCOTT'S BLUFF, NEB.—Plans are being considered by B. A. Lathrop for the installation of an electric light plant in Scott's Bluff.

GOLDFIELD, NEV.—Bids will be received by the Board of County Commissioners until March 6 for furnishing electricity for street lighting in the Town of Goldfield. The system will include 20 arc lamps of 1200 cp.

IRVINGTON, N. J.—The citizens are considering the question of establishing a municipal electric light plant. A committee has been appointed by the Second Ward Improvement Association to look into the matter and ascertain the probable cost and report at the March meeting. It now costs the town between $9,000 and $10,000 per year for street lighting. Warren T. Frey is a member of the committee.

LONG BRANCH, N. J.—The installation of electric lamps from Ocean Avenue to Deal, with provision for an underground conduit system, has been recommended by the special committee and Mayor McFaddin.

NEWARK, N. J.—Arrangements are being made by the New York & New Jersey Telephone Company to erect a new building in Newark, to cost about $500,000, work on which will be started this spring.

FORT BAYARD, N. M.—Bids will be received until March 16 for the construction, including heating, electric wiring and electric light fixtures for three double sets captains' quarters, one nurses' quarters, one steam laundry building and machinery and medical storehouse at this fort. Captain S. P. Vestal is constructing quartermaster.

SILVER CITY, N. M.—It is reported that the plant and holdings of the New Mexico Light, Heat & Power Company have been purchased by J. B. Downey and associates, of Colorado. It is said that the new owners plan to rebuild the plant at a cost of about $15,000.

ALBANY, N. Y.—The contract for supplying the New York State Hospital for the Insane with 25,000 incandescent lamps for the year beginning March 1, 1909, has been awarded to Fairbanks, Morse & Company, of New York, N. Y., for 13.5 cents for 16-cp lamps.

ALBANY, N. Y.—Plans are being made by the Albany Electric Illuminating Company for extensive improvements to its plant and distributing system in this city, which will involve an expenditure of about $300,000. The company is also making arrangements for an extensive exhibit of electrical cooking, heating and lighting apparatus in one of the large department stores this spring.

BERGEN, N. Y.—Plans have been completed for the municipal electric light plant in Bergen, and bids have been advertised for the construction of the plant. The equipment of the plant includes a 270-hp boiler, one 50-hp engine, one 35-kw, direct-current generator, one 100-hp feed-water heater, pump, high-pressure piping, etc. Fred Fish, of Fish & Horton Company, of Rochester, N. Y., is consulting engineer.

ITHACA, N. Y.—The Ithaca & Seneca Falls Interurban Railroad Company is making arrangements to commence the construction of its proposed electric railway this year. The railway will be about 47 miles in length. The power house and repair shops will be located in Ithaca. The company also proposes to furnish electricity for lamps. Jacob Rothschild, of Ithaca, is president.

NEW YORK, N. Y.—The municipal art commission on Feb. 16 approved the designs for the proposed lighting fixtures for the new Police Headquarters, in Centre Street, to cost $20,000.

NEW YORK, N. Y.—Bloomingdale Brothers, Fifty-ninth Street and Third Avenue, New York, have placed an order with Fairbanks, Morse & Company for motors to be used in connection with their vacuum cleaning installation.

NEW YORK, N. Y.—The Public Service Commission of the Second District has granted the New York, Westchester & Boston Railway Company permission to construct its proposed third-rail electric railway from a connection with the New York subway to Port Chester, N. Y.

ONEIDA, N. Y.—The Oneida Railway Company has applied to the Common Council for a franchise to extend its railway from Sherrill to Kenwood.

ROME, N. Y.—The Carey Construction Company, which has the contract for the construction of the water system, has proposed to the Water and Sewer Board the construction of a telephone line from the dam in Fish Creek to the reservoir at Stokes, to cost about $1,200. The board will purchase the system after the completion of the contract, providing the company will construct the plant according to the specifications of the board.

SYRACUSE, N. Y.—The Syracuse, Lake Shore & Northern Electric Railroad Company, which has recently completed its extension from Baldwinsville to Fulton, it is said, will probably extend the railway from Fulton to Oswego, a distance of about 20 miles, during 1909.

SYRACUSE, N. Y.—The Rochester, Syracuse & Eastern Railroad Company, it is reported, will award contracts in March for the construction of

an extension of its railway from Port Byron, N. Y., to Syracuse, a distance of about 35 miles. Surveys have been made, rights of way and franchises secured.

WAPPINGER FALLS, N. Y.—The contract for the construction of the extension to the municipal electric light plant has been awarded to Stehlin-Miller Company, of New York, N. Y., for $9,150.

WARWICK, N. Y.—The Warwick Valley Light & Power Company contemplates installing new dynamos in its plant. Frank Barber is secretary and manager.

GREENSBORO, N. C.—The Proximity Manufacturing Company has placed orders for equipment for its power plant, which will be used to operate the heating and dyehouse machinery. The mill has recently been equipped with electric motors. Electricity for operating the mill will be supplied from the power plant at the White Oak Cotton Mill, owned by the company.

LAURINSBURG, N. C.—R. C. Bibberstein, architect, has been engaged to prepare plans for a factory for the Waverly Cotton Mill, which will be operated electrically. J. P. McRae is president.

SPENCER, N. C.—The Board of Aldermen is considering the question of establishing a municipal electrical light plant. It is proposed to furnish electricity for commercial lighting, as well as for municipal purposes.

WINSTON-SALEM, N. C.—Plans are being made by the Crescent Electric Railway Company to begin work in March on the construction of its proposed electric railway, which will extend from Winston-Salem to Stuart, Va., via Rural Hall, Capella Gap, Vade Mecum, Moore Springs, Piedmont, Danbury and Sandy Ridge, N. C., a distance of 68.9 miles. Surveys have been made and right of way secured, and 20 miles are ready for track laying. E. Hillman, of Aberdeen, N. C., is president.

GRAND FORKS, N. D.—The street lighting committee of the Commercial Club, which has been making investigations in conjunction with the light committee of the City Council in regard to lighting the business streets with ornamental lamps and placing wires underground, has submitted its report. The report recommends the installation of a 100-kw turbo-generator set, a switchboard and a 150-hp boiler in the municipal electric light plant, to cost $8,500. About 202 lamp posts will probably be needed. The total cost of the work is estimated at about $30,300.

NORTON, N. D.—The capital stock of the Norton Farmers' Telephone Company has been increased to $30,000.

CANTON, OHIO.—Negotiations are said to be under way for the consolidation of the Stark County Telephone Company, of this city, and the Massillon Telephone Company, of Massillon. Both are controlled by the United States Telephone Company. It is understood that the Massillon plant is to be improved.

CANTON, OHIO.—Plans are being considered by the Stark County Commissioners for the installation of a cooling system and electric light plant at the County Infirmary. The commissioners would like to receive plans and estimates from manufacturers of such plants. M. W. Oberlin is county auditor.

CLEVELAND, OHIO.—F. C. Kingsbury, of Columbus, Ohio, has been given a franchise to construct and operate an electric light and power plant in this city and also a contract for the street lighting. Under the terms of the contrcat Mr. Kingsbury is to furnish arc lamps at $74.50 per lamp on an all-night schedule and $69 on a moonlight schedule. The plant is to be in operation within eight months.

COLUMBUS, OHIO.—Plans are being considered by the Public Service Board to operate the sewage disposal and garbage disposal plants by electricity, the service to be furnished by the municipal electric plant.

DEFIANCE, OHIO.—As a result of the suit of the C. M. Anderson Coal Company against the People's Gas & Electric Company, argued in common pleas court recently, an agreement has been reached to allow the sale of the property either by the Sheriff or a receiver. That point has not yet been decided, nor has a date for the sale been fixed. The coal company brought suit to collect money due for coal delivered to the local company, and this was followed by an accumulation of claims. The fact that the interest on its bonds was passed caused the Guaranty Savings & Trust Company, which holds $144,500 of them, to foreclose its mortgage on the plant, and F. L. Hay, of this city, was appointed receiver. The franchises of the company expire in October next. The Defiance Street Railroad Company is not affected by the action, as it only rents power from the lighting company.

LE MOYNE, OHIO.—The Le Moyne Telephone Company has increased its capital stock from $2,500 to $10,000.

NATIONAL MILITARY HOME, OHIO.—Sealed proposals will be received at the office of the treasurer, Central Branch, National Home Disabled Volunteer Soldiers, National Military Home, Ohio, until March 18 for addition to central power house, including equipment (boilers and feed water heaters), in accordance with plans and specifications, copies of which, with blank proposals and other information, may be had on application to W. H. Ortt, treasurer.

OTTAWA, OHIO.—The directors of the Putnam Telephone Company have decided to install a new plant in place of the one wrecked by the ice storm recently. Cables will replace many of the lines, and central energy system will be used. The old lines will be repaired to give service until the new system is in working order.

SPRINGFIELD, OHIO.—At a meeting of the stockholders of the Springfield Light, Heat & Power Company, held recently, the proposed issue of $450,000 bonds was approved, the proceeds to be used to pay for the Kelley plant, which was purchased some months ago. As soon as the weather will permit the Kelley plant will be closed and the machinery will be sold. All business will be taken care of from the new plant, the output of which will be increased sufficiently to do this by the coming fall.

WARREN, OHIO.—The Board of Public Service is contemplating the installation of tungsten lamps in the business portion of the city as well as on North Avenue.

ANADARKO, OKLA.—The O'Neil Engineering Company, of Dallas, Tex., has been engaged to take charge of improvements to be made to the municipal electric light plant, for which bids for electrical supplies will soon be asked. The citizens recently voted to issue $14,000 in bonds for the same.

CORDELL, OKLA.—The City Council has granted a franchise to L. L. Landry, H. H. Sherman and J. F. Amis, of Alva, Okla., to construct and operate an electric plant in Cordell.

LAWTON, OKLA.—James M. Sims, of the Federal Trust Company, of St. Louis, Mo.; W. D. Todd, president of the Cornplanters' Refining Company, of Warren, Pa., and C. L. Carson, of St. Louis, Mo., are interested in a project to construct a street railway system in Lawton, for which franchises will be asked at once. The system will include about 15 miles of trackage and will cost approximately $300,000.

NORMAN, OKLA.—Plans are being made by the Norman Telephone Company for extensive improvements to its system.

GRANT'S PASS, ORE.—The Rogue River & Oregon Southern Electric Railway Company has secured franchises from the City of Grant's Pass and the County of Josephine to construct an electric railway on the public highways and streets. The company proposes to construct an electric railway from Grant's Pass through the Rouge River Valley to Waldo, a distance of about 50 miles. A water power on the Illinois River has been located. The company is planning to commence construction work in the spring. O. S. Blanchard, of Grant's Pass, is interested in the project.

MILTON, ORE.—Plans are being considered to extend the transmission lines of the municipal electric light plant to Freewater to furnish electricity for lamps, for which a franchise has been granted by the town of Freewater.

PORTLAND, ORE.—The Columbia River Light & Power Company, recently incorporated, is constructing a hydro-electric plant at Cascade Locks, Ore., but as yet has only installed a temporary plant for use in construction of its plant. According to the present plans, the equipment will include two direct-connected units, consisting of Pelton impulse water-wheels, one with a rating of 200 hp and the other 1333 hp, and 2200-volt, 3-phase, 60-cycle generators. The transmission line will be operated at a potential of 40,000 volts. The intake of pipe line is 4800 ft. above the generating station on Herman Creek. R. W. Lang is secretary.

BEAVER FALLS, PA.—The citizens of College Hill have voted to issue $15,000 in bonds, the proceeds to be used for the construction of an electric light plant. C. S. Caughey is secretary of the Council.

FOREST CITY, PA.—The plant and holdings of the Forest City Electric Company has been purchased by the American Gas & Electric Company. The last named company has secured a franchise to furnish electricity in the Borough of Vandling, and also a contract to furnish street lamps. The plant of the Forest City Electric Company will be closed and electricity for lamps and motors will be supplied by the company's high-tension transmission lines, which will be extended to this city at once. J. Kern is local manager.

GREENVILLE, PA.—The Mercer Construction Company, which is promoting the Greenville electric railway, has purchased the charter of the New Castle-Wilmington Railway, including the franchise in New Castle and the 11-mile right of way between the two towns.

LANSDOWNE, PA.—Bids will be received by John W. Davis, secretary, for lighting the streets of the borough for a term of five years, according to plans and specifications, which can be procured from William C. Shuster, Jr., 17 South Lansdowne Avenue, Lansdowne.

WASHINGTON, PA.—The National Telephone Company has been granted a franchise by the East Washington Council to install a telephone system.

SOMERSET, PA.—The capital stock of the Somerset Telephone Company has been increased from $5,000 to $10,000.

CAMDEN, S. C.—The Wateree Power Company has applied to the Legislature for a charter. The company is to be capitalized at $100,000, with the privilege of increasing it to $3,000,000. The company proposes to construct a hydro-electric on the Catawba and Wateree Rivers. J. T. McDonald, J. D. Harrison, John Boykin, L. C. Harrison, W. S. Lee, J. P. Jones and others are interested in the enterprise.

SENECA, S. C.—It is reported that the contract for the construction of the municipal electric light plant has been awarded to the Piedmont Electric Company, of Anderson, S. C. The equipment will include a 3-phase, 60-cycle, 2300-volt generator; a 95-hp engine and a 115-hp boiler. The street lighting system will consist of 20 arc lamps and 18 incandescent lamps. Bonds to the amount of $25,000 were recently voted for the construction of the plant.

SENECA, S. C.—A. B. Groscoe, of Spartanburg, S. C., and others, have acquired a water power on Change Creek, about ten miles from Seneca, where it is estimated that 1300 hp can be developed.

SENECA, S. C.—L. A. Edwards, president of the Citizens' Bank, is reported to have purchased a water power on Conneross Creek, at High Bridge, which, it is said, he proposes to develop.

STEEDMAN, S. C.—It is reported that work has commenced on the construction of a dam on North Edisto River, where it is proposed to develop from 800 to 1000 hp, which will be utilized to generate electricity to be transmitted to Batesburg, Leesville and Wagners for lamps and motors. The plant will also furnish 250 hp to the Middleburg Mills, at Batesburg. Perry Hall is interested in the enterprise.

SUMTER, S. C.—Bids will be received until March 9 for furnishing the city of Sumter with 50 arc lamps of 2000 cp, with an all-night service, all within a radius of one mile from the center. Also prices on additional lamps as needed, above 50, not exceeding 80. The contract to run 10 years,, beginning Nov. 1, 1909. For further information address C. M. Hurst, clerk and treasurer.

CAMP COOK, S. D.—The capital stock of the Ekalaka Telephone Company has been increased from $5,000 to $25,000.

IROQUOIS, S. D.—The City Council has granted a 20-year franchise to L. W. Liddle, of Iroquois, to install and operate an electric light plant.

PIERRE, S. D.—The Great Western Telephone Company, which was recently purchased by the Gas Belt Telephone Company, is planning to install 10 exchanges and erect 500 miles of telephone lines on the west side of the Missouri River. It also contemplates rebuilding the main line between Fort Pierre and Rapid City with copper wire.

BINGHAMPTON, TENN.—The citizens on Feb. 11 voted to issue $25,000 in bonds, the proceeds to be used for the construction of an electric light plant, water-works system and sewerage system. J. A. Omberg, of Memphis, Tenn., will have charge of the construction of the electric light plant.

CHATTANOOGA, TENN.—The Chattanooga Station Company is making arrangements to install three interlocking electrical switch plants at once. The plants will be used for operation of all tracks in the company's terminal yard, and will cost about $100,000. Electricity for operating the system will be furnished by the Chattanooga Electric Company.

MEMPHIS, TENN.—The Woodward Iron Company is making arrangements to install electrical equipment in its mines on Red Top Mountain.

YORKVILLE (P. O. RUTHERFORD), TENN.—The stockholders of the Yorkville Telephone Company have voted to increase the capital stock of the company from $5,000 to $10,000.

BROWNWOOD, TEX.—It is reported that the West Texas Telephone Company will construct a new telephone system in Brownwood, which will involve an expenditure of about $30,000.

MARBLE FALLS, TEX.—Arrangements are being made to establish a cotton manufacturing plant in connection with the Granite Manufacturing Company's water power development. The plant will have an output of 10,000 hp and will cost about $250,000.

SAN ANTONIO, TEX.—The San Antonio Traction Company contemplates building a 4-mile extension in the near future to Palm Garden, via the stockyards.

NORTON, VA.—Only one bid was received for a 30-year electric light franchise, which was submitted by R. A. Morrison, of Big Stone Gap, Va. It is probable that the franchise will be revised and new bids called for.

RICHMOND, VA.—The State Corporation Commission has granted the Carolina County Telephone Company permission to increase its capital stock from $10,000 to $15,000.

RICHMOND, VA.—Plans are being prepared by C. S. Wenger, Brownsville, Pa., consulting hydraulic engineer, for the power development of the Craig Water Power Company in Virginia. Two power plants are to be constructed, from which electricity will be transmitted to Richmond for lamps and motors. The Meadow Creek installation will develop about 2500 hp under an 800-ft. head, and the equipment will include two impulse water wheels driven units, direct connected, with a rating of 700 kw. The second plant will be located on John's Creek, near Meadow Creek, will be installed later, and will furnish 2500 hp under a 225-ft. head. The company is capitalized at $200,000. The main office of the company is in Richmond, Va. A. L. Sibert is president.

BREMERTON, WASH.—The Peninsula Light & Power Company has been awarded a contract to supply the navy yard at Bremerton with electricity. R. F. Chapman, of Seattle, Wash., is president.

CAMAS, WASH.—A franchise has been granted to Cottrell & Son to install an electric light plant.

MEYERS FALLS, WASH.—The Northwestern Light & Power Company and the Spokane International Railway Company, it is said, will lease the water power at the falls and will commence at once the construction of a hydro-electric plant, to cost about $100,000.

NEWPORT, WASH.—Application has been made to the City Council by H. G. Smith, of Spokane, Wash., general manager of the Panhandle Electric Railway & Power Company, for a franchise to construct and operate an electric light, heat and power plant in Newport.

PALOUSE, WASH.—The Idaho-Washington Light & Power Company is reported to have taken over the plant and holdings of the Palouse Light & Power Company. It is understood that the new owners will make improvements to the plant. M. J. Shields is president.

PASCO, WASH.—Application has been made to the City Council by J. B. Hubrich for a franchise to operate a street railway system in Pasco.

TENINO, WASH.—The Tenino Light, Water & Power Company has awarded the contract for the construction of a new power house and installation of an additional 150-kw alternator, a 200-kw, 500-volt, direct-current generator, and a 250-hp Corliss engine, to Edwin C. Amme Company, of Portland, Ore. The transmission line from Blumauers to Tenino is finished and it is expected to have the plant completed in about 60 days.

WALLA WALLA, WASH.—The Walla Walla Valley Traction Company is in the market for four 1000-hp water wheels, two 500-kw units, either steam or gas, for auxiliary plants, and one 500-kw unit for a hydro-electric plant. F. S. Drake is manager.

WHEELING, W. VA.—Bids will be received by Captain F. W. Altstaetter, U. S. Engineer Office, Wheeling, W. Va., until March 24, for furnishing and installing gas engines, compressors, special machinery, piping, etc., for operating the locks at dams Nos. 13 and 18, Ohio River.

BLAINE, WIS.—The capital stock of the St. Louis Farmers' Mutual Telephone Company has been increased from $3,000 to $6,000.

CEDARBURG, WIS.—The Milwaukee Northern Railway Company contemplates double tracking its railway, now in operation, from Milwaukee to Cedarburg, and also to construct a single-track from Cedarburg to West Bend this year.

CUMBERLAND, WIS.—The McKinley Telephone Company contemplates increasing its capital stock to $10,000, and will establish a local exchange in Cumberland.

ELLSWORTH, WIS.—The capital stock of the Pierce County Telephone Company has been increased from $50,000 to $100,000.

MERRILL, WIS.—The Western Electric Company, Chicago, Ill., is reported to have secured the contract for the installation of additional machinery at the Grandfather Falls plant. The equipment will include a 1100-kw generator, switchboard and one 140-hp exciter set in the power house, and a 1100-kw transformer at the mill. The cost of the improvements is estimated at $25,000.

SPARTA, WIS.—Jacob Cloos, of Milwaukee, Wis., consulting engineer, has been engaged by the committee on street lighting to make investigations as to the feasibility of installing a municipal electric light plant in Sparta.

WAUSAU, WIS.—The Wausau Street Railway Company is preparing plans for the construction of an electric interurban railway to connect Grand Rapids with Port Edwards and Nekoosa, for which preliminary surveys are now being made between Grand Rapids and Nekoosa.

CHEYENNE, WYO.—The United Smelters, Railway & Copper Company, capitalized at $12,500,000, has purchased the properties of the Penn-Wyoming Copper Company, which has been operating the Ferris-Haggerty and Rambler copper mines, the Battle Lake-Encampment six-mile aerial tramway, the smelters and mills at Encampment, Wyo.; water, light and power companies, banking and mercantile institutions, which recently completed the Saratoga & Grand Encampment Railway, which extends from Walcott to Encampment, a distance of 46 miles. The price paid is said to be $10,000,000.

FORT YELLOWSTONE, WYO.—Bids will be received by Lieut. G. C. Smith, constructing quartermaster, Ft. Yellowstone, Wyo., until March 13 for construction of electric power house. Also at the same place and date, separate proposals will be received for equipment for the power plant as follows: Three 280-hp Francis type water turbines, with governors, complete, 940 r.p.m., to work under a head of 280 ft.; three 150-kw, direct-connected revolving field, 3-phase, 2200 or 2300-volt, 60-cycle, 950 r.p.m. generators and three 8-kw exciters, with switchboard and all connections; approximately 2200 ft. of 26-in. spiral, ¼-in. thick, riveted steel penstock, including air chamber; the lighting equipment for an electrical power house. These items should be bid for separately, but a lump sum for the whole apparatus will be considered. Plans and specifications furnished upon application to the above office.

CHEMAINUS, B. C., CAN.—Arrangements are being made by E. J. Palmer, of Chemainus, to replace the present motive power at his lumber mills with electricity. It is proposed to install a plant adequate to furnish electricity for lighting the entire town. A 115-kw generator and switchboard will be installed. Power for operating the plant will be furnished by the present boiler plant, where refuse matter is used for fuel. Thirty-five arc lamps will be erected about the yards and the buildings will be wired throughout and electrical equipment installed for operating hoists for handling lumber. Hinton & Company, of Vancouver, have the contract for installing the apparatus.

SYDNEY, N. S., CAN.—The Sydney-East Bay Electric Tramway Company has applied to the Council of Cape Breton for a franchise to construct and operate an electric railway from Sydney to the southern end of East Bay, with branches and spurs 17 miles in length. Surveys are now being made for the railway.

TORONTO, ONT., CAN.—Arrangements are being made by the Hydro-Electric Power Commission to erect a telephone line parallel with its electric transmission lines.

MEXICO CITY, MEX.—The Mexican Northern Power Company has secured a valuable franchise from the Mexican government for water power rights on the Conchos River. The company is capitalized at $10,000,000. E. B. Greenshields, of Montreal, Que., is vice-president.

Company Elections.

SANTA ROSA, CAL.—At the annual meeting of the Petaluma & Santa Rosa Railway Company the following officers were elected: E. M. Van Frank, president; J. A. McNear, vice-president, and Thomas Archer, secretary and treasurer.

EVANSVILLE, IND.—At the annual meeting of the Evansville, Mt. Carmel & Onley Interurban Company the following named officers were elected: Aden Knoph, president; Elmer Q. Lockyear, secretary; Lewis Seitz, treasurer, and C. J. Siebert, general manager.

DOVER, MAINE.—At the annual meeting of the Dover & Foxcroft Light & Heat Company the following named officers were elected: C. C. Hall, president; E. A. Thompson, treasurer, and Eugene W. Crocker, clerk.

DETROIT, MICH.—At the annual meeting of the Eastern Michigan Edison Company the present board of directors was re-elected.

DETROIT, MICH.—At the annual meeting of the Detroit Edison Company the present board of directors was re-elected.

SHARON, PA.—At the annual meeting of the Shenango Valley Railway & Light Company the following named officers were elected: N. McD. Crawford, of New York, N. Y., president; Leighton Calkins, of New York, N. Y., secretary, and A. C. Rogers, of Youngstown, Ohio, treasurer.

New Industrial Companies.

THE C. J. LITSCHER COMPANY, of Grand Rapids, Wis., has been chartered for the purpose of dealing in electrical supplies, telephone equipment, automobiles, etc.

THE STERLING ENGINEERING COMPANY, of Newark, N. J., has been incorporated, with a capital stock of $100,000, by Roland D. Crocker, Harry H. Poole and William H. Daly.

THE HENRY H. MEYER COMPANY, of Baltimore, Md., has been chartered by John T. Donohue, Timothy J. Hooper, of Baltimore, Md. The company proposes to deal in engines and boilers.

THE OLIVER ROTO COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 to do a general electrical business by G. Raymond Collins, C. A. Fry and Hugh A. Caperton.

THE FUNK MACHINE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $50,000 by T. Hill, of Quincy, Ill.; N. E. Funk and J. B. Wentworth, both of New York, N. Y.

THE ELECTRIC BANK PROTECTIVE COMPANY, of Dover, Del., has been incorporated, with a capital stock of $200,000, by R. C. Birkholm, N. M. Lynch and C. D. Voels, of New York, N. Y.

THE LEBETT MANUFACTURING COMPANY has been incorporated under the laws of New Jersey, with a capital stock of $800,000, for the purpose of manufacturing electric dynamos, motors, batteries, etc.

THE NEVILLE ILLUMINATING SIGN COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $50,000 by C. S. Neville, C. F. Beezley and R. E. Nicholson. The company proposes to manufacture signs.

THE BABCOCK ELECTRIC GARAGE & SALES COMPANY, of Cleveland, Ohio, has been incorporated with a capital stock of $25,000 by E. J. Blandin, Joseph Hidy, Albert E. Green, Frank H. Ginn and J. M. Garfield.

THE NORTHERN EQUIPMENT COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $20,000 to manufacture and sell steam power and electrical appliances. The incorporators are: Charles M. Clark, R. Blom and F. Cederberg.

THE CALUMET ELECTRICAL CONSTRUCTION COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $2,500 to carry on a general electrical manufacturing and construction business by Charles J. Carroll, James McGovern and Orie A. Keeler.

THE CONTINENTAL ELECTRIC COMPANY, of Baltimore, Md., has been incorporated with a capital stock of $2,500 by Herluf A. F. Peterson, Joseph I. McAllister and Lindon E. Richardson. The company proposes to do a general electrical contracting business.

BRUNS, KIMBALL & COMPANY, of Jersey City, N. J., have been chartered with a capital stock of $35,000 by W. Bruns, C. C. Kimball, of Jersey City, N. J., and M. C. Kimball, of New York, N. Y. The company proposes to deal in and repair motors, engines, etc.

THE FRALEY HAND VIBRATOR COMPANY, of New York, N. Y., has been chartered with a capital stock of $5,000 to manufacture electrical and mechanical instruments. The incorporators are: John T. Booth, James M. Tully, Lewis V. Hulse, all of New York, N. Y.

THE KIRKPATRICK CONDUIT COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $2,500 by Edward F. Kirkpatrick, Edwin Terwilliger, Jr., and Archibald K. Bonham. The company proposes to do a general contracting and merchandise business.

THE NATIONAL LIGHT & MANUFACTURING COMPANY, of Edgewater, N. J., has been incorporated with a capital stock of $50,000 by D. M. Barrett, H. M. Brown and E. J. Gorham, all of New York, N. Y. The company proposes to manufacture gas lamps, fixtures, etc.

THE QUEENS ENGINEERING COMPANY, of New York, N. Y., has filed articles of incorporation, with a capital stock of $6,000, to do general construction work. The incorporators are: Thorburn Reid, Frederick C. Mearns, of New York, N. Y., and Robert Brown, of Norfolk, Va.

THE NILSON, MILLER COMPANY, of Hoboken, N. J., has been incorporated by H .S. Nilson, J. E. Miller, L. G. Nilson and E. Miller, all of Hoboken, N. J. The company is capitalized at $25,000, and proposes to do a general mechanical and electrical engineering business, toolmakers, machinists, etc.

THE LIGHTER MANUFACTURING COMPANY, of New York, N. Y., has been incorporated with a capital stock of $35,000 to manufacture electric cigar lighters and other lighting devices. The incorporators are: W. J. Setzer, of Brooklyn, N. Y.; W. A. Walling and E. W. Fuchs, of New York, N. Y.

JACOBUS & HIGGINS, of Jersey City, N. J., have filed articles of incorporation with a capital stock of $25,000, and propose to do a general engineering, surveying and developing business. The incorporators are: W. M. Jacobus, of Rutherford, N. J.; C. H. Higgins and S. Wearst, of Jersey City, N. J.

THE UNITED STATES ELECTRICAL SIGNAL COMPANY, of Boston, Mass., has been chartered with a capital stock of $15,000 to manufacture electric signals of all kinds. The officers are: George B. Bullord, of West Newton, Mass., and Roland Gammons, of Newtonville, Mass., treasurer and clerk.

THE AMERICAN THERMOSTAT COMPANY, of Elmira, N. Y., has filed articles of incorporation, with a capital stock of $25,000. The incorporators are: Burchard C. Johnson, Arthur McClellan and Byron R. Johnson, all of Elmira, N. Y. The company proposes to manufacture thermostats, electrical devices, etc.

THE A. A. AUTOMATIC MANUFACTURING COMPANY, of New York, N. Y., has been chartered with a capital stock of $100,000 by A. Aderer, W. M. Lambert, Z. S. Oppenheimer and M. W. Gorge, all of New York, N. Y., and R. Markowitz, of New Jersey. The company proposes to manufacture electric cooking utensils.

THE SIRIUS COMPANY, of New York, N. Y., has been chartered with a capital stock of $10,000 by R. Fulton Rubens, Mitchell F. McCarthy and Ralph J. Sachers, all of New York, N. Y. The company proposes to manufacture machinery and appliances useful in electrical, mechanical, chemical and manufacturing trades.

THE CHICAGO CONTRACTING & ENGINEERING COMPANY, of Chicago, Ill., has filed articles of incorporation. The company is capitalized at $30,000, and proposes to install and operate power and heating plants and to operate machine and repair shops. The incorporators are: John M. Blakely, Arthur B. Blakely and H. H. Talcott.

THE NATIONAL ARIAL NAVIGATION COMPANY OF AMERICA, of Clinton, N. Y., has filed articles of incorporation with the Secretary of State. The company is capitalized at $25,000 and proposes to manufacture electrical devices or machines for navigation. The incorporators are: G. H. Allen, J. G. Kirby and L. M. Martin, of Clinton, N. Y.

THE TOLEDO INCANDESCENT LAMP COMPANY, of Toledo, Ohio, has been incorporated with a capital stock of $25,000 by A. Q. Thatcher, C. M. Edson, W. S. Delehanty, W. W. Hill and A. C. Tefft. Mr. Thatcher will be the president of the company, and Mr. Edson, secretary and treasurer. The business of the Toledo Refill Lamp Company, 933 Summit Street, will be taken over and the output of the plant increased from 1,000 lamps per day to 5,000.

New Incorporations.

LITTLE ROCK, ARK.—The West Memphis Belt Line & Terminal Railroad Company has been incorporated to construct an electric railway, 12.14 miles in length. The incorporators are: Edwin Boysden, of Wheatley; R. L. Mixon, H. F. Roleson, W. E. Ayers, J. B. Badgett and others, of Marion.

MERCED, CAL.—The Dos Palos Telephone Company has been incorporated by H. T. Reynolds, A. S. Woodhouse, George Christien and others.

SAN DIEGO, CAL.—The San Diego & El Cajon Valley Interurban Railway Company has been chartered to construct an electric railway from La Mesa Springs through Alta to a point near Lakeside, a distance of 15 miles. The directors are: William B. Gross, Edward Fletcher, of Pasadena, and Thomas Ballantyne, of El Cajon, Cal.

DENVER, COL.—The Denver, Colorado Springs & Pueblo Interurban Electric Railroad Company has filed articles of incorporation, with a capital stock of $1,500,000, to construct an electric railway from Denver through Colorado Springs to Pueblo. The incorporators are: L. M. Pfeiffer, William S. Binford, F. C. Lewis, Charles Lederer and A. E. Van Dusen.

DOVER, DEL.—The Paintsville Water & Light Company has filed articles of incorporation with the Secretary of State, with a capital stock of $300,000. The incorporators are: Edwin D. Lanel, L. D. Brooks and Martin Garnet, all of Philadelphia, Pa.

CHICAGO, ILL.—The Independent Telephone & Telegraph Company has been incorporated, with a capital stock of $15,000, by Daniel F. Flannery, Archibald A. McKinley and William McKinley.

NAUVOO, ILL.—The Independent Telegraph & Telephone Company

has been chartered with a capital stock of $15,000 by Daniel F. Flannery, Archibald A. McKinley and William McKinley.

WELLINGTON, ILL.—The Wellington Farmers' Telephone Company has been incorporated, with a capital stock of $1,200, by Monroe Garrison, Daniel Stewart and John C. Benbow.

CROSS PLAINS, IND.—The Farmers' Mutual Telephone Company has been organized, with a capital stock of $890, to operate a mutual telephone line. Daniel Denmore is president of the company, and Martin Vanosdall, secretary and treasurer.

INDIANAPOLIS, IND.—Articles of incorporation have beeen filed for the Central Mutual Telephone Company with a capital stock of $1,000 to construct and operate a telephone system in Sullivan County. The directors are: Philip T. Lloyd, Herschel V. Stark, Charles Moore, Ira S. Anderson and William H. Bennett.

CRESTON, IA.—The Iowa & Southwestern Railway Company has been chartered, with a capital stock of $300,000, to construct an electric railway between Clarinda, College Springs and Blanchard, a distance of 18 miles. The officers are: William S. Farquar, of College Springs, president; J. N. Miller, of Clarinda, vice-president; J. H. Walkinshaw, of Blanchard, vice-president; L. H. Taggart, of College Springs, treasurer, and A. F. Galloway, of Clarinda, secretary.

RICHMOND, MAINE.—Articles of incorporation have been filed for the Richmond Electric Company, with a capital stock of $10,000, for the purpose of generating and distributing electricity and gas. The officers of the company are: C. D. Newell, president; H. E. Houdlette, treasurer, and H. C. Reed, clerk, all of Richmond, Maine.

SALISBURY, MD.—The Wicomico Electric & Power Company has been organized to construct an electric railway from Salisbury and Nanticoke Point, a distance of 24 miles. It is reported that bids have been received, but contract not yet awarded for the work. The officers are: Marion V. Brewington, president; L. W. Dorman, vice-president; Mark Cooper, secretary; William M. Cooper, treasurer, and Jesse D. Price, general manager.

CURRYVILLE, MO.—The People's Telephone Company has been organized to construct and operate a rural telephone line. E. Sparks is president of the company, and Ira Stone, secretary and treasurer.

RICH HILL, MO.—The Ray Telephone Company has been organized by the residents of the Mound Valley district to erect a telephone line to connect with the Rich Hill telephone exchange. James Baughan is president; Peter Flexner, vice-president; George J. Reik, secretary, and Frank Ford, treasurer.

HARLEMVILLE (P. O. GHENT), N. Y.—The Harlemville-Chatham Co-operative Telephone Company has been formed, with a capital stock of $600, to erect and operate a telephone line from Harlemville to Chatham. John B. Jones and William H. Angel, of Ghent, and John Freehan and Frank Wolfe, of Austerlitz, are interested in the enterprise.

OSWEGO, N. Y.—Articles of incorporation have been filed for the City Traction Company with the Secretary of State to construct and operate an electric railway from Oswego to Seneca Hill, a distance of 10 miles. The company is capitalized at $550,000. The directors are: Cadwell B. Benson, of Minetto; William Nottingham, Clifford D. Beebe, of Syracuse, and Harold C. Beatty, of Skaneateles.

RALEIGH, N. C.—The Ivanhoe Manufacturing Company has been incorporated by W. M. Sanders, J. H. B. Franklin, T. R. Hood, N. B. Grantham, T. C. Jordan, and others of Smithfield, and B. B. Adams, of Four Oaks. The company is capitalized at $300,000 and proposes to manufacture cotton warps, hosiery or underwear yarns and manufacture and distribute electricity and operate electric railways in Smithfield and Johnston Counties.

NEW HOME, N. D.—The Sykeston & New Home Telephone Company has been incorporated, with a capital stock of $10,000, by C. C. Guenther, D. Jensen, John Ran and others, of New Home, N. D.

SHERWOOD, N. D.—The Barber Telephone Company has been organized to construct telephone lines in Calquhoun, Prosperity and Grover townships. W. J. Doyle is secretary and treasurer.

Personal.

MR. HARRY D. BAYNE has resigned as Eastern manager of the Canadian Westinghouse Company.

MR. A. H. PICKLER, electrical engineer with the Crocker-Wheeler Company, has been elected president of the American Society of Hungarian Engineers and Architects, recently organized in New York City. Messrs. Zoltan de Nemeth and Sandor Oesterreicher, of the New York Edison Company, have been elected sercetary and treasurer, respectively, of the society.

MR. CHARLES H. PORTER has resigned as instructor in electrical engineering at the Massachusetts Institute of Technology to accept a position with William Filene's Sons & Company, of Boston. Mr. Porter entered the institute from Brown University with the degree of A. B. and was graduated in 1903. After spending a year with the Chase-Shawmut Company, he returned to the Tech. as instructor.

MR. EDWIN H. CHENEY.—The announcement of the appointment of Mr. Edwin H. Cheney as manager of the Chicago district of the Wagner Electric Manufacturing Company, with headquarters in the Marquette Building, Chicago, is a source of gratification to his wide circle of friends and acquaintances in the electrical field. Since his graduation in the electrical engineering course of the University of Michigan, in 1892, Mr. Cheney has been located in Chicago. After graduation, he entered the employ of the Chicago Edison Company as chief draftsman, and was subsequently connected with its construction department until 1899. He left that company to become treasurer and manager of the Mutual Electric Company of Chicago, an electrical construction concern, which office he filled until 1901, when he resigned, to become secretary and treasurer of the Illinois Maintenance Company. This position he held for five years, discontinuing his connection with the company to become president of the Fuel Engineering Company, resigning, in turn, to accept the appointment of the Wagner Electric Manufacturing Company as its Chicago district manager. Mr. Cheney's energy, ability and personality, as well as his thorough knowledge of electrical manufacture and installation, make him a valuable acquisition to the Wagner staff.

MR. E. H. CHENEY.

Obituary.

MR. EDWARD H. BOWEN, associate editor of the *Telegraph Age*, New York, died suddenly of apoplexy on Sunday, Feb. 21.

MR. JOHN STARR, of Halifax, N. S., senior member of John Starr, Son & Company, of Halifax, N. S., electrical engineering and contracting firm, died at his home in that city Feb. 15. Mr. Starr was in his 81st year and is survived by two sons and four daughters.

MR. EDWIN REYNOLDS, for many years head of the engineering department of the Allis-Chalmers Co., died at Milwaukee Feb. 18 after a long illness at the age of 77. Mr. Reynolds was one of the foremost designing steam engineers of the world and some of his types of engines have enjoyed a reputation only second to the original Corliss. One of his achievements was the adaptation of the Corliss principles to engines for electrical generation.

Trade Publications.

TELEPHONES.—The Connecticut Telephone & Electric Company, Meriden, Conn., has issued catalog No. 20-W, covering intercommunicating telephone.

LAMP GUARDS.—Guards for protecting incandescent electirc lamps are listed, described and illustrated in a booklet issued by the F. Bissell Company, Toledo, Ohio.

PANEL BOARDS for various duties are described in the February issue of "Trumbull Cheer," issued by the Trumbull Electric Manufacturing Company, Plainville, Conn.

STEAM PUMPS.—Pony Catalog No. 76 of the Dean Brothers Steam Pump Works, Indianapolis, Ind., gives brief descriptions and illustrations of standardized styles and sizes of steam pumps.

ELECTRIC WASHING MACHINES.—The Metropolitan Electrical Supply Company, of Chicago, Ill., has issued a special bulletin describing the "Thor" electric washing machine, for which it is selling agents.

MOTORS FOR SEWING MACHINES.—Bulletin No. 3907 of the Emerson Electric Manufacturing Company, St. Louis, Mo., is devoted to alternating-current and direct-current motors for driving sewing machines.

GROUNDING CLAMPS for use with Sprague flexible conduit and B-X conductors, and clamps for rigid conduit, are listed in a leaflet issued by the Novelty Electric Company, 50 North Fourth Street, Philadelphia, Pa.

STEAM ENGINES of the simple slide-valve type, rated at from 12 hp to 71 hp, traction engines for all duties and hoisting apparatus, are treated quite fully in Catalog No. 61 of the Heilman Machine Works, Evansville, Ind.

REFLECTORS.—The Pettingell-Andrews Company, Pearl Street and Atlantic Avenue, Boston, Mass., has issued an attractive catalog devoted to "Opalux" reflectors and artistic fixtures that have been designed for use with these reflectors.

WATT-HOUR METERS.—Much valuable technical information concerning all types of watt-hour meters, but especially those of the mercury-motor type, is given in a bulletin issued by the Sangamo Electric Company, Springfield, Ill.

ARC LAMPS.—The Charles L. Kiewert Company, Milwaukee, Wis., has issued illustrated folders dealing with flaming arc lamps and electrodes. The folders cover "Alba" and "Aurola" lamps, giving data, prices and performance characteristics.

MAGNET WIRE.—Rubber covered and bare copper wire are well described in an attractive catalog issued by the Electric Cable Company, Bridgeport, Conn. The catalog gives much specific information concerning the diameters, weights, resistance, etc., of the various wires discussed. Attention is called to the increasing importance of asbestos-covered wire.

LARGE TRANSFORMERS of the shell type for both single-phase and three-phase service are thoroughly discussed in Bulletin No. 4640 of the General Electric Company, Schenectady, N. Y. The bulletin contains also information intended to assist a customer in determining whether air-blast or water-cooled transformers will be more suitable for a given installation.

GAS ENGINES of the horizontal, single-cylinder, four-stroke cycle, are well discussed in an illustrated catalog issued by the Fort Wayne Foundry & Machine Company, Fort Wayne, Ind. Detailed descriptions are given of the constructive features and performance of the engines. A folder issued by the same company gives information concerning suction gas-producer plants of the Burger type.

MOTOR-GENERATORS.—The General Electric Company, Schenectady, N. Y., has issued Bulletin No. 4644, which describes a motor-generator set particularly suited for use in connection with search lanterns, welding, for motor service, or as a reversible booster for battery service. The generator is of the Rosenberg type, capable of giving constant current at variable speed or constant output with variable resistance.

ALTERNATING-CURRENT SWITCHBOARDS are described in detail in Bulletin No. 31 of the F. Bissell Company, Toledo, Ohio. The bulletin covers single-phase, two-phase and three-phase generator, feeder and totalizing panels, as well as exciter panels. Information is given concerning instruments, switchboard parts and appliances. The bulletin contains numerous line drawings of standard boards and price-lists of completed boards and accessories.

ELECTRICITY IN THE WOOD-WORKING INDUSTRY.—A description of the combined direct-current and alternating-current equipment of the plant of the Great Southern Lumber Company, Bogalusa, La., is contained in Bulletin No. 4641 of the General Electric Company, Schenectady, N. Y. An outline of the advantages to be derived from electricity in the wood-working industry is given, together with a discussion of the relative merits of alternating current and direct current.

Business Notes.

DR. ALFRED MULLER, who furnishes expert advice upon foreign patents, designs, trademarks and copyrights, has removed his office from 60 Wall Street to 2 Rector Street, New York.

THE BANNER ELECTRIC COMPANY has moved its Atlanta office from the English-American building to more commodious quarters in the Candler building. Mr. Joel Mann Martin is in charge as Southern manager.

DOSSERT & COMPANY, of New York, have received orders through the Association of Edison Purchasing Agents for 1,500 fuse-box plugs, 1,200 flat shank-lugs, 500 three-way connectors and 500 grounding caps, all of the Dossert solderless type.

THE ROBERTSON ELECTRIC COMPANY, of Buffalo, N. Y., has consolidated with the Cataract Electric Supply Company, also of Buffalo. The new company will move into the Court Inn Building, 37-39 Court Street, Buffalo, N. Y. William E. Robertson is general manager.

CROCKER-WHEELER ORDERS.—Among the recent orders taken by the Crocker-Wheeler Company, of Ampere, N. J., is one for a 250-kw motor-generator set for the Tennessee Coal, Iron & Railroad Company, at Ensley, Ala. It will consist of a 250-kw, 275-volt, direct-current, generator driven by a 6600-volt, three-phase, 25-cycle synchronous motor and will be used as an exciter. Another order is one for about 50 hp of small elevator motors from the Haughton Elevator & Machine Company, of Toledo, Ohio. Yawman & Erbe, of Rochester, N. Y., have also placed order for a number of 2/5-hp motors for use on some of their specialties.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED FEB. 16, 1909.

[Conducted by William F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

912,301. BLOCK-SIGNALING SYSTEM; N. P. Fraser, Carsonville, Mich. App. filed Jan. 30, 1908. In combination with an insulated block of which the rails are electrically separated, of a conductor, connecting the diagonally opposite ends of the rail, together with a source of electric current in the conductor and an electric signal so arranged that a train moving onto the rails will short-circuit the current and release the signal.

912,339. APPARATUS FOR HANDLING THE ELECTROLYTIC PRODUCTS OF BRINE IN THE TREATMENT OF FIBER; W. V. Wentworth and A. B. Larchar, Oldtown, Me. App. filed Jan. 29, 1907. The cell is provided with an evaporator for concentrating the caustic soda, together with a receiving chamber into which the concentrates are discharged without intermitting the evaporation and a filter tank for separating the caustic soda from the salt.

912,340. PROCESS OF HANDLING THE ELECTROLYTIC PRODUCTS OF BRINE IN THE TREATMENT OF FIBER; W. V. Wentworth and A. B. Larchar, Oldtown, Me. App. filed Jan. 29, 1907. Process of treating brine which consists in electrolyzing, then concentrating the caustic soda effluent of the electrolysis, then collecting the concentrate and separating the same into its caustic soda and salt constituents.

912,346. COLLISION-PREVENTING DEVICE FOR RAILROADS; F. Wolf, New York, N. Y. App. filed Oct. 30, 1907. Actuates the brake and shuts off the power of a locomotive automatically, one of the rails forming a continuous electrical conductor, the other rail being interrupted at suitable distances, the parts being connected to a suitable contact arrangement.

912,350. BRUSH-HOLDER; H. L. Zabriskie, Brooklyn, N. Y. App. filed Sept. 9, 1904. An interchangeable brush-holder of the box type in which the pressure of the carbon brush against the commutator bar is regulated by a coil spring which may be tensioned by a ratchet.

912,351. PROCESS OF CHARGING LEAD-PEROXID-ZINC STORAGE BATTERIES; R. Ziegenberg, Berlin, Germany. App. filed Aug. 8, 1907. The process of charging lead-peroxid-zinc storage batteries, consisting in placing the positive and negative plates, normally dischargeable in sulphuric acid, in a substantially neutral solution of zinc sulphate, and in maintaining the charging bath in a substantially neutral condition by inserting therein zinc not in electrical connection with the plates.

912,359. AUTOMATIC SIGNAL-ALARM; P. A. Brown, Denver, Col. App. filed March 22, 1905. The bell hammer is provided with a part carrying a pawl which works a ratchet carrying a make and break wheel so as to send out signals to any desired circuit.

912,363. ELECTROMAGNETIC ORE-SEPARATOR; T. Charlton, Chicago, Ill. App. filed Oct. 7, 1907. Two magnetic pole pieces of opposite polarity, one of which is in the form of a rotating roll. The axes of the pole pieces are arranged in an inclined plane. Details.

912,364. INSULATOR FOR ELECTRICALLY CHARGED WIRES; S. Jackson Conrad, Cedar Rapids, Iowa. App. filed July 17, 1908. A recess is formed in the outside of the insulator and a spring catch placed therein to engage the insulator and prevent its removal.

912,384. AUTOMATIC ENGINE STOP-VALVE; J. L. Kimball, Salem, Mass. App. filed May 8, 1907. A balanced puppet valve comprising two connected disks, together with a vent port controlled by an electromagnet so as to unbalance the valve or to balance it and permit the valve to fall by gravity to stop the engine.

912,385. AUTOMATIC ENGINE STOP-VALVE; J. L. Kimball, Salem, Mass. App. filed March 27, 1908. A valve with two actuators for moving the valve in opposite directions, both acted upon by pressure on the inlet side of the valve to balance it, each actuator having exhaust passage so as to permit the other actuator to operate with electrically operated means controlling one of the exhaust passages and hand-operated means controlling the other.

912,400. TROLLEY-HEAD AND GUARD; J. G. McGuffey and R. P. Dowler, Groveport, O. App. filed Jan. 2, 1908. A trolley pole with a casing and a troller wheel slidably mounted within the casing, together with guard arms pivotally mounted in the said casing and means carried by the trolley wheel for operating the arms.

912,427. TROLLEY; S. B. Sickelsmith, Newhaven, Pa. App. filed April 7, 1908. The pole is provided with a pivotal section at the end, the said section carrying a trolley wheel at the outer end and being spring-pressed by a spring pushing against the inner end.

912,432. VALVE ALARM ATTACHMENT; R. F. Spamer, Chicago, Ill. App. filed Oct. 12, 1905. A local circuit extends through the building to be protected so that whenever the valve is tampered with it rings an alarm. The valve is provided with a detachable casing and a removable head with three contacts carried by the head, two in a local circuit and the other grounded.

912,433. ALARM FOR SIGNAL LAMPS; W. K. Sparrow, South Nyack, N. Y. App. filed June 18, 1908. Gives an automatic alarm for signal lamps for automobiles and lighthouses. Provided with a thermocouple which starts a current and gives a signal if the lamp should go out.

912,447. CIRCUIT CONTROLLER; R. W. Coffee, Richmond, Va. App. filed May 15, 1906. For explosive engines in which a plurality of contacts, mounted on spring arms, make contact with fixed contacts, together with a rotatable shaft, which normally holds the contacts out of engagement and allows them to successively operate.

912,454. ALARM CLOCK; C. Fesenbek, Philadelphia, Pa. App. filed Oct. 6, 1908. Rings an alarm when the bolt is unlocked. Details.

912,459. BRAKE APPARATUS; S. G. Freund, New York, N. Y. App. filed March 27, 1908. For the automatic application and release of brakes when the speed of the train has been reduced to a predetermined degree, the operation being repeated on a further decrease of speed. Combines the braking apparatus with a motor and a plurality of solenoids of differing voltages in circuit with the motor.

912,471. ELECTRICALLY HEATED FLATIRON; E. D. Holley, Forestville, and C. L. Root, Bristol, Conn. App. filed Feb. 29, 1908. Provides an iron base plate with a copper heat distributor having a homogeneous surface union with the plate.

912,501. HIGH-TENSION INSULATOR; J. K. Soden, Chicago, Ill. App. filed July 15, 1907. Prevents current leakage due to wet surfaces by providing a housing or jacket surrounding the insulator, the base portion of the jacket admitting air at its lower portion which circulates about the insulator.

912,504. ELECTRICAL CLUTCH AND BRAKE; A. P. Steckel, Buffalo, N. Y., and Francis DuP. Thomson, Wheeling, W. Va. App. filed July 15, 1907. An electrical induction brake or clutch having magnetized pole pieces and a conducting ring supported adjacent to the pole pieces. The ring may move to allow for expansion and contraction.

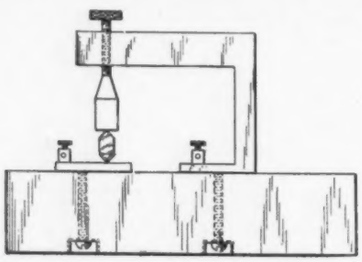
912,514. ELECTRICAL LAMP FIXTURE; N. Weeks, Richmond Hill, N. Y. App. filed June 21, 1901. Cluster lamp socket in which the lamp carrying sockets and their contacts are mounted directly upon the insulating base. Details.

912,529. PLURAL LAMP SOCKET; R. B. Benjamin, Chicago, Ill. App. filed July 27, 1906. Access to the binding posts of the device is obtained by removing the cover or casing instead of removing a bushing from each of the threaded shells of the sockets.

912,542. MULTIPLE-UNIT SWITCH; H. W. Cheney, Norwood, Ohio. App. filed Aug. 30, 1905. For operating two or more adjacent single-pole switches by means of a solenoid. Each switch has a separate operating mechanism, including a rotatable shaft, a walking-beam lever and a solenoid, and means are provided for connecting together any desired number of shafts, the solenoids being energized simultaneously to operate the switches in unison.

912,551. FIELD STRUCTURE FOR DYNAMO-ELECTRIC MACHINE; A. B. Field, Norwood, Ohio. App. filed Jan. 22, 1906. Avoids the strains produced by centrifugal force on strap-wound coils by bending portions of the coils so as to incline them to the axes of the poles so as to reduce the shearing stress due to centrifugal force.

912,555. TIME CUT-OUT; John Gardner, Fleetwood, England. App. filed Sept. 19, 1905. Time cut-out for electrical circuits provided with a continuously rotatable disk of magnetic material with two magnets arranged on opposite sides of the disks, one of variable



912,613—Oscillation Detector and Rectifier.

strength and a movable part carrying the magnets and displaceable in one direction or the other according to which magnet exerts a preponderating influence on the disk.

912,556. TROLLEY STAND OR BASE; C. J. Geterman, Canton, Ohio; App. filed June 4, 1908. A compression spring is arranged upon a rod and a trolley-pole carrier is pivoted upon rotary support and bears against the rear end of a crosshead on the rod at a point below the pivot of the carrier, whereby the spring is compressed, as the free end of the trolley is depressed.

912,557. TROLLEY STAND OR BASE; C. J. Geterman, Canton, Ohio. App. filed June 4, 1908. A trolley stand provided with a rotary support and a combined elevating and buffer spring, together with a sliding abutment adapted to compress the spring and links connecting the abutment with the trolley-pole carrier.

912,565. DYNAMO-ELECTRIC GENERATOR; J. O. Heinze, Jr., Lowell, Mass. App. filed Nov. 11, 1907. Relates to magnetos with several permanent magnets forming the field so that when one is demagnetized the magnetism from the remaining magnets passes through the armature instead of through the demagnetized maget. Makes use of iron armature sections rotatable in their respective fields each magnetically independent of the adjacent magnet.

912,573. THERMOSTATIC INSTRUMENT; C. S. Johnson, Boston, Mass. App. filed Dec. 17, 1907. A movable strip member elongates under heat and co-operates with a fixed contact. Abnormal movements are prevented by providing a backstop co-operating with the movable member to limit its contactive movement away from the fixed member.

912,594. HICKEY; Louis McCarthy, Boston, Mass. App. filed Oct. 23, 1908. For connecting the stem of an electrolier to the insulating joint which is connected to the outlet. It consists of a separable two-part member which engage the insulating joint and fixture, respectively, and are in slidable engagement with each other, the two members having registering openings for the wires and means for rigidly connecting the members.

912,612. COMMUTATOR FOR MOTORS; A. J. Pfaff, St. Louis, Mo. App. filed April 29, 1908. A commutator head is provided with rings of hard and smooth insulating cement arranged adjacent to the ends of the segments that are mounted in the head.

912,613. OSCILLATION DETECTOR AND RECTIFIER; G. Whittier Pickard, Amesbury, Mass. App. filed Sept. 3, 1907. An individual conducting crystal of low conductivity with a metallic deposition upon its edge. The crystal consists of carborundum.

912,639. ELECTRIC-LIGHTED SIGN; C. F. Ziegler and R. A. Bartling, Chicago, Ill. App. filed Sept. 25, 1907. A flashing sign. Electric lamps are rotated to illuminate the sign. A hollow rotatable shaft carries hollow arms which carry the lamps. The wires are led through the shaft and arms to the lamps.

912,701. TELEPHONE ATTACHMENT; A. W. Lyda, Pittsburg, Pa., and E. C. Robinson, Lowellville, Ohio. App. filed July 17, 1908. A mouthpiece attachment for holding a disinfectant which covers the mouthpiece of a telephone and is provided with an advertising device. Details.

912,705. BATTERY HOLDER; C. T. Mason, Sumter, S. C. App. filed Dec. 19, 1908. For holding a series of dry cells comprising a frame or support and a series of cell-connectors carried thereby, each connector including a circular spring clip adapted to engage the casing of the cell and a resilient conductor tongue integral with and extending from the clip.

912,720. ELECTRIC LIGHT SOCKET; M. Norden, New York, N. Y. App. filed July 18, 1908. Relates to supporting electric light bulb sockets from the circuit wires, each bulb adapted to receive a plurality of electric lights. Details.

912,726. OSCILLATION RECEIVER; G. W. Pickard, Amesbury, Mass. App. filed Oct. 15, 1908. A fragment of chalcopyrite in electrical contact with a substantially rough, unpolished fracture surface of the electrically conducting mineral red oxid of zinc.

912,734. COIN-CONTROLLER ELECTRICAL APPARATUS; A. W. Roovers, Brooklyn, N. Y. App. filed Oct. 1, 1906. For giving shocks. Is provided with two movable handles so connected that they move in unison, one insulated from the other, and an indicating mechanism indicating the extent of movement of the handles and, consequently, the strength of current passing through the user.

912,765. ELECTRICALLY HEATED TOOL; M. J. Wohl, New York, and A. A. Low, Horseshoe, N. Y. App. filed Feb. 10, 1908. A detachable tip for a soldering iron so coupled to the body that the heat of the body is conducted to the tip. The tip has a plurality of tongues which engage the size of the body. The body is electrically heated.

912,778. TELEPHONE CORD PROTECTOR; E. T. Banes, Philadelphia, Pa. App. filed Jan. 23, 1908. A bushing of resilient material which prevents the cord from wearing, by contact with the metal part of a plug. It consists of a split sleeve of elastic material on the cord at the inner end of the plug.

912,786. ELECTRIC SIGNAL SYSTEM; V. L. Beeman, Wellington, Ohio. App. filed May 25, 1908. For indicating in the locomotive cab or at the despatcher's office the position of the train by dividing the line into blocks with track relays and circuit wires extending along the track to the relays, together with a reversible train magnet whose poles reverse according to the direction being traveled so as to energize the track relays and close the circuit.

912,801. ELECTRIC CONDUCTOR; S. G. Brown, London, England. App. filed Dec. 11, 1903. Electric cables for submarine work having an inner conductor, an outer conductor, a closed iron magnetic circuit developing the inner conductor and a dielectric between the inner conductor and the magnetic envelope and between the latter and the outer conductor.

912,822. TELEPHONE SYSTEM; W. W. Dean, Chicago, Ill. App. filed Jan. 23, 1904. A two-wire type of telephone system in which the cut-off relays are actuated by current over the talking circuit. A common battery system in which there is associated with each line a line signal and a line relay, the latter controlling normally open contacts in the local circuit of the signal. There is also provided a cut-off relay for each line to establish a path of low resistance about the line relay to render it inoperative.

912,831. DEVICE FOR INDICATING THE INTENDED MOVEMENTS OF VEHICLES; Percy Seymour Douglas-Hamilton, Queen's Gate Gardens, London, England. App. filed Dec. 31, 1907. For signaling the movement of an automobile at night by illuminating a hand which shows red and is in a horizontal position on the left-hand side of the vehicle when the driver intends to turn to the left and which illuminates two upright hands when he intends stopping.

912,859. ELECTROLYTIC CELL FOR SEPARATING CONSTITUENTS OF A MIXTURE OF METAL OR AN ALLOY; H. Lacroix, Geneva, Switzerland. App. filed July 2, 1908. The material which drops from the anode is collected separately from that which drops from the cathode. One of the electrodes is surrounded by a diaphragm, the lower end of which opens into a chamber separate from the rest of the body of the cell.

912,871. CONTROLLER FOR ELECTRIC MOTOR; R. L. Munson, Seattle, Wash. App. filed Feb. 11, 1908. A starting-box which may be used as a phase splitter which is dust proof and ventilated and so that the cores carrying the coils may be separately removed and replaced. Has a hinged cover and a parallel series of spring socket clips, one series carried by the cover, together with detachable resistance coils mounted in the clips and exposed by turning back the cover.

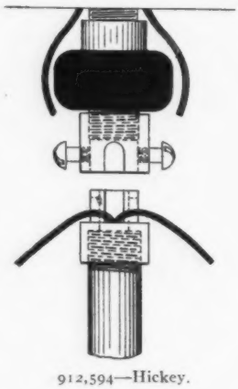
912,878. TELEPHONIC RECEIVER; A. H. Nicholson, Wendover, England. App. filed Sept. 2, 1908. Comprises a permanent horseshoe magnet, with two parallel diaphragms between the poles, a bar electromagnet between the diaphragms and a circular wedge-shaped piece carrying the bar magnet.

912,961. RAIL JOINT; H. S. Shafer, Nazareth, Pa. App. filed Aug. 13, 1908. The abutting ends of the rails are recessed and a plug mounted in the recess which connects the rails electrically. A current-conducting wire passes through the plug and extends into the recesses.

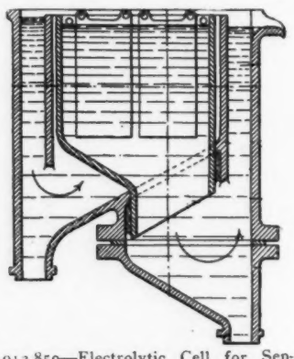
912,968. TELEPHONE REPEATING APPARATUS AND CIRCUIT; J. J. Skidmore, Boston, Mass. App. filed May 9, 1907. Adjusts the sensitiveness of the telephone apparatus in order to secure the electrical balance between the line sections so as to prevent the active disturbances without attention from the switching operator. Inserts a resistance connected to an element of a jack which bears a predetermined relation to the line to which the jack belongs.

912,916. RAIL BOND; C. R. Sturdevant, Worcester, Mass. App. filed Jan. 13, 1906. Rail bonds for electric railways having at the ends terminals, each terminal comprising a plurality of solid metal stud-bearing branches adjustable toward and from each other.

912,924. COIN-CONTROLLER ELECTRICAL DEVICE OR MACHINE; J. Weiner, Cleveland, Ohio. App. filed March 7, 1908. For giving shocks. A magneto generator has a crank member which is



912,594—Hickey.



912,859—Electrolytic Cell for Separating Constituents of a Mixture of Metal or an Alloy.

turned by one hand of the user, the circuit being closed through this hand and a hand-hold which is grasped by the other hand of the user.

912,946. DRY BATTERY CELL; G. N. Eastman, Riverside, Cal. App. filed Aug. 12, 1908. Avoids leaking of the fluid by constructing the metal electrode of tubular form and incasing it in an adhesive fibrous material of sufficient rigidity to preserve the form of the electrode.

912,970. ELECTRIC ALARM WATER GAGE; G. C. Marsh, Denver, Col. App. filed April 8, 1908. The float is an electric conductor and closes the circuit between the electrodes so as to ring an alarm when the water has reached a high or low level within the boiler or other receptacle with which the gage is connected.

912,974. BRUSH HOLDER; J. F. Elroy, Albany, N. Y. App. filed Nov. 22, 1904. A brush holder having jaws which grip the brush and pivoted at its opposite end to a conducting support provided with a binding post for the leading-in wire. Details.